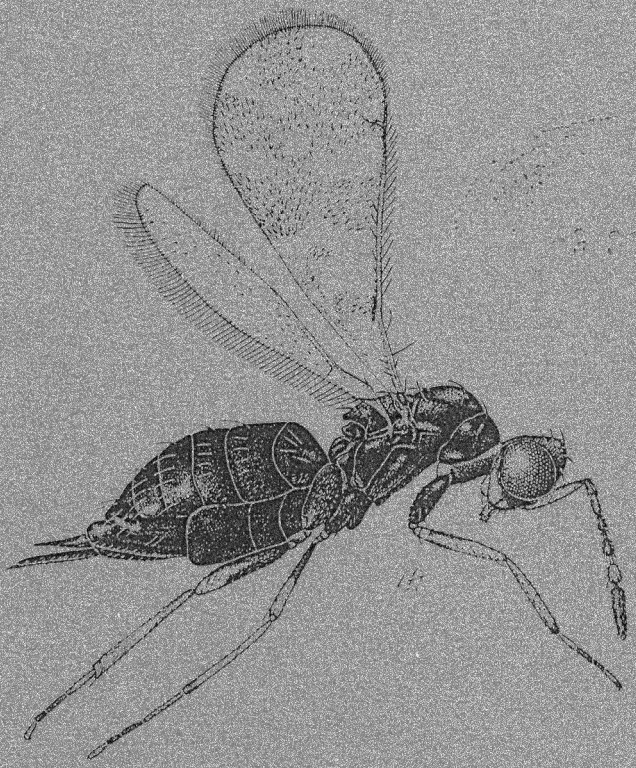
THE AUSTRALIAN Entomologist

published by
THE ENTOMOLOGICAL SOCIETY OF QUEENSLAND



Volume 30, Part 3, 30 September 2003
Price: $6.00 per part

ISSN 1320 6133

THE AUSTRALIAN ENTOMOLOGIST

The Australian Entomologist is a non-profit journal published in four parts annually by the Entomological Society of Queensland and is devoted to entomology of the Australian Region, including New Zealand, Papua New Guinea and islands of the south-western Pacific. Articles are accepted from amateur and professional entomologists. The journal is produced independently and subscription to the journal is not included with membership of the Society.

Subscriptions

Subscription are payable in advance to the Business Manager, The Australian Entomologist, P.O. Box 537, Indooroopilly, Qld, Australia, 4068.

For individuals:	A$25.00 per annum in Australia.
	A$30.00 per annum in Asia-Pacific Region.
	A$35.00 per annum elsewhere.
For institutions:	A$30.00 per annum in Australia.
	A$40.00 per annum in Asia-Pacific Region.
	A$40.00 per annum elsewhere.

Cheques in currency other than Australian dollars should include an extra A$7.00.

ENTOMOLOGICAL SOCIETY OF QUEENSLAND

Membership is open to anyone interested in Entomology. Meetings are normally held in the Department of Zoology and Entomology, University of Queensland on the second Monday of March-June and August-December each year. Meetings are announced in the Society's News Bulletin which also contains reports of meetings, entomological notes, notices of other Society events and information on Members' activities.

Enquiries relating to the Society should be directed to the Honorary Secretary, Entomological Society of Queensland, C/- Department of Zoology and Entomology, University of Queensland, Brisbane, Qld, 4072.

Sustaining Associates

Centre for Identification and Diagnotics, The University of Queensland; Pest Management Research, Department of Natural Resources; Tropical Fruit Fly Research Group, Griffith University.

Cover: Minute wasps of the eulophid genus *Astichus* are mostly parasites of the larvae of ciid beetles living within the fruiting bodies of bracket fungi. This undescribed species is about 2mm in length and occurs in the rainforests of eastern Australia from southern New South Wales north to the Wet Tropics of Queensland. Illustration by Geoff Thompson.

NEW SPECIES AND RECORDS OF TRYPETINAE (DIPTERA: TEPHRITIDAE) FROM AUSTRALIA AND THE SOUTH PACIFIC

D.L. HANCOCK[1] and R.A.I. DREW[2]

[1]*PO Box 2464, Cairns, Qld 4870*

[2]*Australian School of Environmental Studies, Griffith University, Nathan, Qld 4111*

Abstract

Calosphenisca ndomae sp. n. and *Euphranta lemniscoides* sp. n. are described from Solomon Islands. *Euphranta ochrosiae* sp. n. is described from Papua New Guinea. *Aciuropsis pusio* Hardy and *Euphranta lemniscata* Enderlein are newly recorded from Australia and New Caledonia respectively. Host plant and/or distribution records are noted for a further 23 species, including several new records for Papua New Guinea, Solomon Islands and Vanuatu.

Introduction

Australian and Pacific Island fruit flies belonging to the subfamily Trypetinae have been studied intermittently in recent years, following revisions published for Australia (Permkam and Hancock 1995) and the Indonesia, Papua New Guinea and Solomon Islands region (Hardy 1983, 1986, 1987). In an earlier review (Hancock and Drew 1994), we concentrated on islands of the south-central Pacific. The present study reports on new and interesting records from Australia and the southwestern Pacific, including the descriptions of three new species from Papua New Guinea and the Solomon Islands.

The following abbreviations for specimen depositories have been used: AQIS – Australian Quarantine & Inspection Service, Mareeba and Broome; QDPI – Queensland Department of Primary Industries, Brisbane; QMB – Queensland Museum, Brisbane; UQIC – University of Queensland Insect Collection, Brisbane. Tribal classification follows Korneyev (1999).

Systematics

Tribe ADRAMINI

Adrama selecta Walker

Material examined. PAPUA NEW GUINEA: 1 ♀, Morobe Province, 10 km W of Lae, nr Markam River, banana plantation, 10-16.vii.1999, Yeates *et al.*, malaise, lowland rainforest (QMB); 1 ♀, Milne Bay Province, Dabora Village, 1.iii.2000, bred from *Gnetum gnemon*, S 875; 4 ♀♀, Madang Province, Ohu, 14.xii.2000, bred from *Barringtonia calyptocalyx*, M 632 (all QDPI).

Comments. Some of the above specimens were bred from the fruit of *Barringtonia calyptocalyx* (Lecythidaceae) and there is a single record from *Gnetum gnemon* (Gnetaceae). For other host plants see Hancock *et al.* (2000).

Coelotrypes flavinus (Hering)

Material examined. PAPUA NEW GUINEA: 1 ♀, Western Highlands Province, Kuk, 13.viii.1982, J.W. Ismay, swept sweet potato; 7 ♂♂, 3 ♀♀, Eastern Highlands Province, Aiyura Research Station, staff residential area, 23.ii.1999, 23.iii.1999, 29.ix.1999, 10.xi.1999 & 19.iv.2001, Leon Saleu, ex cue lure and methyl eugenol traps P419 (all QDPI).

Comments. Species in genus *Coelotrypes* Bezzi breed in the flower buds of *Ipomoea* spp. (Convolvulaceae) and sweet potato is a likely host.

Euphranta leichhardtiae Permkam & Hancock

Material examined. AUSTRALIA: 1 ♀, SE Queensland, nr Fresh Water Lake, Cooloola, 3-13.iii.1970, E.C. Dahms, rainforest, at light (QMB).

Comments. The above is an additional locality for this little-known eastern Australian species. It has been bred from the fruit of *Rauwenhoffia leichhardtii* (Annonaceae) (Permkam and Hancock 1995).

Euphranta lemniscata Enderlein

Material examined. NEW CALEDONIA: 1 ♂, 21°07'S, 164°57'E, 30 m, Tiea Reserve, 4-5.xi.2001, G. Monteith, at UV light (QMB).

Comments. This widespread species is newly recorded from New Caledonia.

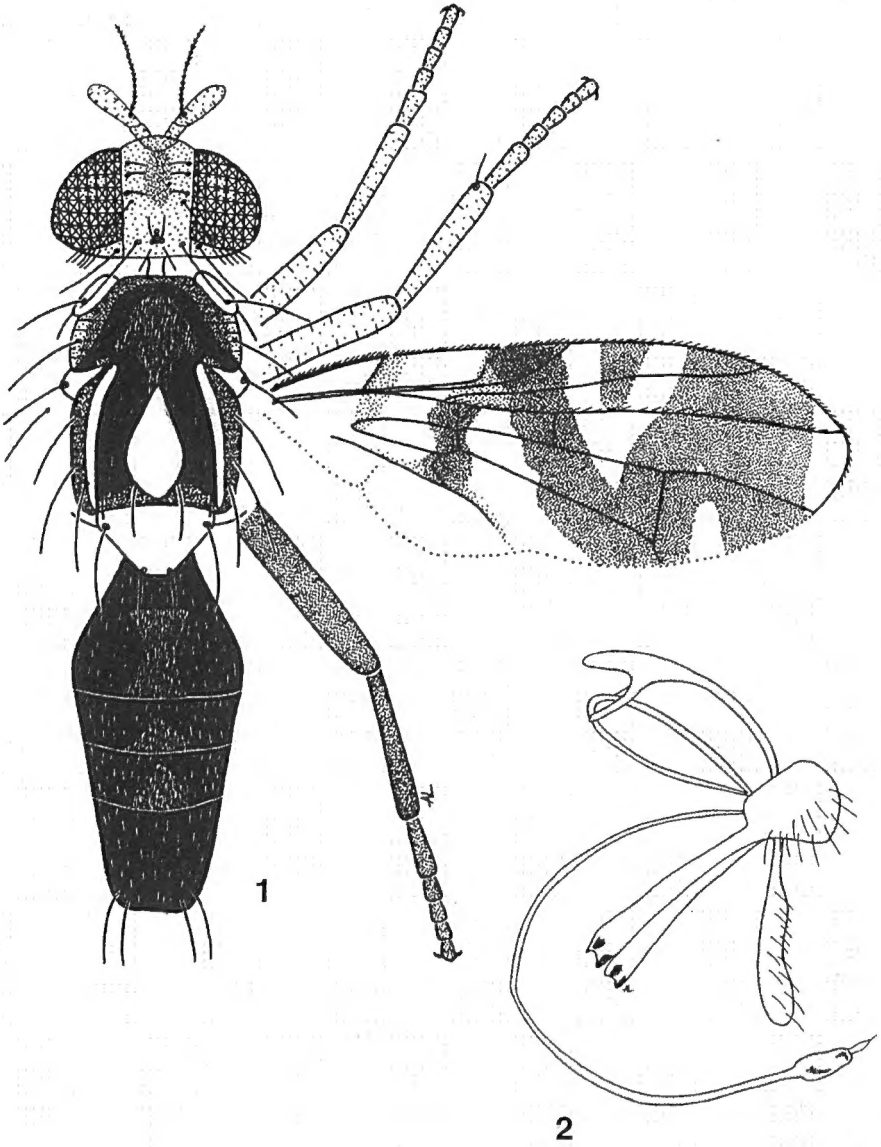
***Euphranta lemniscoides* sp. n.**

(Figs 1-2)

Types. *Holotype* ♂, SOLOMON ISLANDS: W Guadalcanal, Tangarare, 21.x.1997, F. Tsatsia, hand collected on cut end *Vitex* sp. (in QMB, Reg. No. T 99079). *Paratypes*: 3 ♂♂, Central Guadalcanal, Mt Austen, 20.x.1995, R.G. Hollingsworth *et al.*, SI 1346 (QDPI).

Description. Male (Fig. 1). Length of body 8.5 mm; of wing 7.8 mm. Head fulvous, slightly higher than long. Antennae yellow; arista plumose. Face concave, with a greyish sheen but no dark markings. Frons pubescent, with 3 pairs of frontal and 1 pair of orbital setae, the upper frontals aligned with orbitals; on 1 specimen a weaker fourth pair of frontal setae present on line of orbitals, the third pair of frontals shifted anteriorly; ocellar setae weak or vestigial.

Thorax largely black except pleura partly to extensively red-brown and with yellow-white markings as follows: postpronotal lobes; lateral postsutural vittae from suture to enclose intra-alar setae; a large prescutellar elliptical spot narrowing anteriorly to a point towards suture; a broad band on upper half of anepisternum, connected by a narrow extension with postpronotal lobe; katatergite. Notoplera fulvous to red-brown, connected to postpronotal lobes by a lateral band yellow dorsally and brown ventrally. Scutellum yellow; subscutellum and mediotergite black. With a full complement of thoracic setae except presuturals; dorsocentrals placed midway between supra-alars and prescutellar acrostichals; 2 anepisternals; 4 scutellars. One specimen has 2 pairs of postpronotal setae and 3 anepisternal setae, the upper pair close together. Haltere yellow. Legs fulvous except fore and mid tibiae red-brown and hind tibiae tending black; middle tibia with an apical black spine; fore femur slightly swollen and with a row of 4-6 ventral black setae.



Figs 1-2. *Euphranta lemniscoides* sp. n. (1) male; (2) male genitalia.

Wing hyaline with a transverse fulvous subbasal band across base of cell c to base of cell bcu, a dark blackish-brown transverse band from below middle of cell c to apex of cell bcu, connected to pterostigma by yellow base of cell r_1, and a large blackish-brown apical area from pterostigma to hind margin of wing, leaving apex hyaline (including apices of cells r_{2+3} and m_1), a hyaline indentation posteriorly in cell m and a hyaline V-shaped band from costa to upper part of cell dm between the R-M and DM-Cu crossveins; blackish-brown band in hyaline V reaches vein R_{4+5}. Pterostigma blackish-brown except narrowly yellow basally. Veins R_1 and R_{4+5} setose; R-M crossvein near middle of cell dm, below apex of pterostigma; cell bcu apically acute.

Abdomen elongate; black except tergite I+II with a quadrate or hourglass-shaped medial marking and terga III and IV each with a posterior triangular to quadrate marking, narrowest anteriorly; these markings fulvous with a greyish sheen. Tergite V elongate, about as long as terga III and IV combined; posterior margin of tergite V varies from yellow to black. Male genitalia (Fig. 2) with proctiger and surstyli very elongate.

Female. Unknown.

Host plant. The Mt Austen paratypes were bred from a vine tentatively identified as *Merremia peltata* (Convolvulaceae).

Distribution. Known only from Guadalcanal, Solomon Islands.

Comments. E. lemniscoides is very similar to *E. lemniscata* in wing pattern but the markings are darker and the apical hyaline area is larger in the former. In *E. lemniscoides* the thorax and abdomen are mostly black (generally fulvous to red-brown in *E. lemniscata*) and the proctiger and surstyli are much longer (c.f. *E. lemniscata* in Permkam and Hancock 1995). Both species appear to breed in the fruit of Convolvulaceae.

Euphranta marginata Hardy

Material examined. PAPUA NEW GUINEA: 46 ♂♂, 50 ♀♀, Madang Province, Baitabag, 24.v.2000, 4, 11 & 25.x.2000, 15.xi.2000, 30.v.2001, 6, 13, 20 & 27.vi.2001, 4 & 25.vii.2001, 11 & 22.viii.2001, bred from *Neuburgia corynocarpa*; 1 ♀, same data except 25.vii.2001, ex *Ochrosia coccinea*, M 1769; 8 ♂♂, 8 ♀♀, Madang Province, Ohu, 4.x.2000, 8.ii.2001 & 21.vi.2001, bred from *Neuburgia corynocarpa* (all QDPI).

Comments. Most of the above specimens were bred from the fruit of *Neuburgia corynocarpa* (Loganiaceae); the single record from *Ochrosia coccinea* (Apocynaceae) is an error. *E. marginata* was known previously only from the holotype female from Morobe Province (Hardy 1983).

Euphranta marina Permkam & Hancock

Material examined. PAPUA NEW GUINEA: 1 ♀, Western Province, Mabaduan [coast N of Saibai I.], 4.iii.1993, R. Stephens, collected on board boat (QDPI).

Comments. This coastal Australian species is newly recorded from Papua New Guinea. It breeds in the mangrove *Avicennia marina* (Verbenaceae).

Euphranta numeralis Permkam & Hancock

Material examined. AUSTRALIA: 1 ♂, SE Queensland, 27°26'S, 152°50'E, Enoggera Creek at Scrub Rd, Brisbane Forest Park, 7-9.i.1993, R. van Klinken, rainforest, bred *Maclura cochinensis* [sic] fruit (UQIC).

Comments. This species was known previously only from the holotype male from New South Wales (Permkam and Hancock 1995). The above specimen was bred from fruit of *Maclura cochinchinensis* (Moraceae).

***Euphranta ochrosiae* sp. n.**

(Figs 3-6)

Types. *Holotype* ♂, PAPUA NEW GUINEA: Madang Province, Baitabag, 1.viii.2001, bred from *Ochrosia coccinea*, M 1826 (in QMB, Reg. No. T 99080). *Paratypes*: 2 ♂♂, 4 ♀♀, same data as holotype; 52 ♂♂, 43 ♀♀, same data except 2.viii.2000, M 176b; 28.ii.2001, M 950; 28.iii.2001, M 1106; 25.iv.2001, M 1238; 2 & 9.v.2001, M 1265 & 1291; 3, 20 & 27.vi.2001, M 1507, 1540 & 1591; 4, 11, 19, 25 & 29.vii.2001, M 1623, 1677, 1718, 1728, 1769 & 1777; 1, 8, 15, 22 & 29.viii.2001, M 1809, 1826, 1864, 1884, 1918, 1958, 1980, 1993 & 2021; 31.x.2001, M 2540 & 2549; 3 ♂♂, 3 ♀♀, same data except 5.ix.2001, bred from *Myristica* sp., M 2035 (4 in QMB, Reg. Nos T 99081-99084; others in QDPI).

Description. Male (Fig. 3). Length of body 6.8 mm; of wing 6.0 mm. Head fulvous, slightly higher than long. Antennae yellow with third segment fuscous; arista plumose. Face concave, with a greyish sheen but no dark markings. Frons fulvous laterally, red-brown medially, with a black central marking across apical half; pale pubescent; with 2 pairs of frontal and 1 pair of orbital setae, the frontal setae widely separated with the upper pair just before the orbitals; ocellar setae absent. Occiput largely black behind eyes.

Thorax mostly black, with greyish tomentosity on anepisternum, along suture and as a broad medial band on scutum, widest posteriorly; dorsal half of postpronotal lobe and notopleural callus dark fulvous; ventral half of postpronotal lobe brown; a broad, yellow prescutellar marking, bordered by dorsocentral setae. Scutellum yellow with a broad black basal band; subscutellum and mediotergite black. With a full complement of thoracic setae except presuturals and prescutellar acrostichals; dorsocentrals placed midway between supra-alars and scutellum; 2 anepisternals; 4 scutellars. Haltere pale yellowish-white. Legs with fore femur fulvous with a medial brown band, mid and hind femora and all tibiae blackish-brown and tarsi dark fulvous; middle tibia with an apical black spine.

Wing hyaline with a dark blackish-brown transverse band from pterostigma to basal half of cell dm, bordered distally by R-M crossvein, and a large blackish-brown apical area enclosing DM-Cu crossvein and curving inwards posteriorly, leaving apex hyaline (including apices of cells r_{2+3} and m_1), the

two dark areas separated by a hyaline band from cell r_1 at apex of pterostigma to wing margin; cell m with a weak hyaline indentation posteriorly; cell cu_2 entirely hyaline. Pterostigma blackish-brown. Vein R_1 setose; vein R_{4+5} with a few setae near base; R-M crossvein placed before middle of cell dm, below subapical part of pterostigma; cell bcu apically acute.

Abdomen elongate; black except terga I+II and III with a quadrate red-brown medial area, overlaid with greyish tomentosity. Tergite V a little longer than tergite IV. Male genitalia (Fig. 4) with proctiger and surstyli elongate.

Female. As for male except terga IV-VI laterally fulvous; tergite VI as long as tergite V; oviscape black, as long as terga IV-VI combined; aculeus (Fig. 5) short, with distinct subapical teeth and apical serrations; three spermathecae (Fig. 6) with smooth, oval heads and constricted necks. On the head the frontal setae vary in position from widely separated with the upper pair just before the orbital setae to close together and situated anteriorly.

Host plant. Almost all of the type series were bred from the fruit of *Ochrosia coccinea* (Apocynaceae); the record from *Myristica* sp. (Myristicaceae) appears to be a host misidentification.

Distribution. Known only from Madang Province, Papua New Guinea.

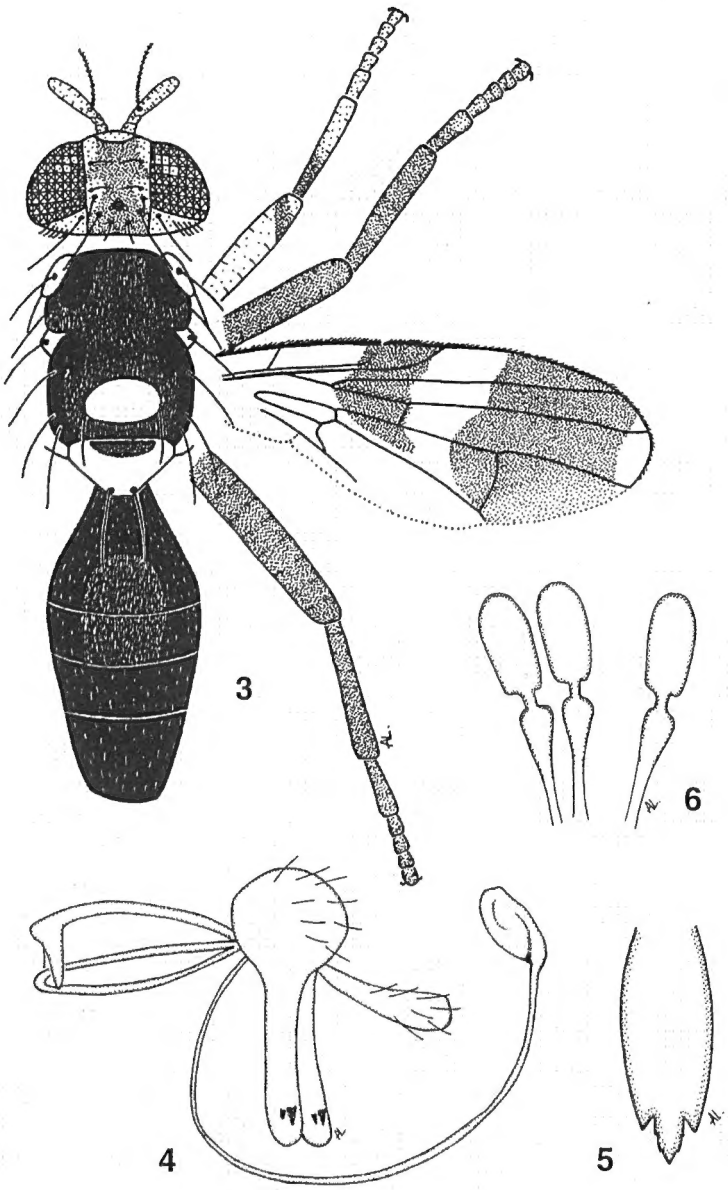
Comments. E. ochrosiae is similar to *E. vitabilis* Hardy but in *E. ochrosiae* the apical hyaline wing spot is larger, the dark transverse band from the pterostigma is broader (enclosing entire base of cell r_{2+3}) and bordered distally by the R-M crossvein (not broadly enclosing it). In addition, the basal margin of the apical brown area is irregularly curved (almost sinuous) in *E. ochrosiae* and evenly curved in *E. vitabilis*.

Euphranta ochrosiae belongs to a small group of Apocynaceae-feeding species that includes *E. cerberae* Hancock & Drew from southern Thailand, *E. scutellata* Malloch from Solomon Islands and presumably *E. vitabilis* (host unknown) from the Bismarck Archipelago (and possibly mainland New Guinea – see Hardy 1983).

Euphranta perkinsi Hardy

Material examined. PAPUA NEW GUINEA: 4 ♂♂, 3 ♀♀, Central Province, Laloki Agric. Res. Stn, 7.i.1993, D. Tenakanai, reared from *Faradaya splendida*, F. Muell., L 184; 11 ♂♂, 11 ♀♀, Madang Province, Ohu, 28.vi.2000 & 19.x.2000, bred from *Morinda bracteata*, M 130a & M 446; 1 ♂, Madang Province, Baitabag, 22.viii.2001, bred from *Ochrosia coccinea*, M 1980 [? label error] (all QDPI).

Comments. Most of the above specimens were bred from the fruit of *Morinda bracteata* (Rubiaceae). Records from *Faradaya splendida* (Verbenaceae) and *Ochrosia coccinea* (Apocynaceae) appear to be errors; these hosts are used by other species of *Euphranta* Loew. The Baitabag specimen may be a mislabelled specimen from the Ohu series. Host sample M 446 (*M. bracteata*) produced 67 flies.



Figs 3-6. *Euphranta ochrosiae* sp. n. (3) male; (4) male genitalia; (5) female aculeus; (6) spermathecae.

Euphranta perkinsi was described from West Papua, Indonesia (Hardy 1983) and recorded from Papua New Guinea by Permkam and Hancock (1995).

Euphranta quatei Hardy

Material examined. PAPUA NEW GUINEA: 1 ♂, 2 ♀♀, Madang Province, Ohu, 24.v.2001 & 4.vii.2001, bred from *Gmelina moluccana*, M 1372 & M 1653; 2 ♂♂, Madang Province, Baitabag, 16.v.2001, bred from *Chionanthus sessiflorum*, M 1323 (all QDPI).

Comments. Known previously only from the holotype male from West Papua, Indonesia (Hardy 1983), this species is newly recorded from Papua New Guinea. Its host plant appears to be *Gmelina moluccana* (Verbenaceae), the two samples yielding eight (M 1372) and six (M 1653) flies respectively. The record from *Chionanthus sessiflorum* (Oleaceae) requires confirmation.

Euphranta scutellata Malloch

Material examined. SOLOMON ISLANDS: 15 ♂♂, 22 ♀♀, NE Guadalcanal, Vovota, 20.i.1995, R. Wylie *et al.*, bred from *Cerbera manghas*, SI 0674 (QDPI).

Comments. Known previously only from the holotype and allotype from an unspecified locality (Malloch 1939, Hardy 1983). The above series was bred from the fruit of *Cerbera manghas* (Apocynaceae).

Euphranta variabilis (Kertész)

Material examined. AUSTRALIA: 1 ♀, N Queensland, 1 km N of 'Eclectus', Iron Range, 12°45'45"S, 143°17'11"E, 12.vii.1977, G. & A. Daniels (UQIC). PAPUA NEW GUINEA: 1 ♂, Morobe Province, Labu-butu area, Markam River, 6.x.1999, S. Balagawi/ S. Sar, cue lure P429 (QDPI).

Comments. The above localities are additional to the few previously recorded for this species (Hardy 1983, Permkam and Hancock 1995). The host plant remains unknown.

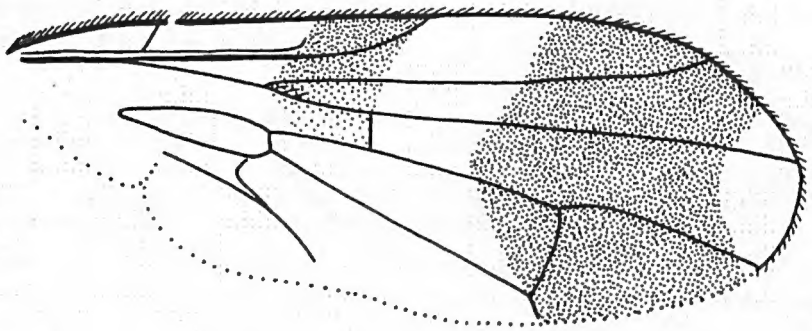


Fig. 7. *Euphranta* sp. indet., wing.

Euphranta sp. indet.
(Fig. 7)

Material examined. PAPUA NEW GUINEA: 1 ♀, Central Province, Paga Hill, Port Moresby, 16.iv.1967, Sir Alan Mann (QDPI).

Comments. This species appears to be related to *E. latifasciata* Hardy but the thorax is entirely orange-yellow, the abdomen red-brown and the basal wing band yellow. The head is missing and the specimen too badly damaged to describe.

Hardyadrama presignis (Hardy)

Material examined. AUSTRALIA: 1 ♀, Torres Strait, Saibai I., 10.xii.2002, N. Mosby, in ME lure trap (AQIS, Mareeba).

Comments. The above is the second record of this species from Australia, being recorded previously from Warraber (Sue) I., also in Torres Strait (Permkam and Hancock 1995).

Tribe HEXACHAETINI

Callistomyia flavilabris Hering

Material examined. PAPUA NEW GUINEA: 2 ♂♂, 9 ♀♀, Madang Province, Baitabag, 28.vi.2000, bred from *Wenzelia dolichophylla*, M 119; 1 ♀, same data except 13.vi.2001, M 1498 (all QDPI).

Comments. Previously recorded from Misool (Maluku Province, Indonesia) and newly recorded from Papua New Guinea. A dark brown facial spot is present or absent and this species differs from *C, pavonina* Bezzi in having the large oval wing spot shallower, not extensive in cell r_{2+3}. In *C. horni* Hendel this large oval spot is distinctly connected to the transverse band behind it. The above series was bred from the fruit of *Wenzelia dolichophylla* (Rutaceae).

Callistomyia horni Hendel

Material examined. AUSTRALIA: 1 ♂, Western Australia, Augustus I., 17.iii.2002, A. Postle (AQIS, Broome). PAPUA NEW GUINEA: 1 ♂, 1 ♀, Central Province, 20 km SE Port Moresby, 11.iii.1983 & 26.i.1985, J.W. Ismay; 1 ♂, Burns Peak, Port Moresby, 2.v.1971, J. Pippet (all QDPI); 1 ♂, 1 ♀, Central Province, Hall Sound [near Yule Island], McL. (UQIC).

Comments. This species is newly recorded from Western Australia. It is widespread in northern Australia but in Papua New Guinea all known records emanate from Central Province in the south.

Tribe RIVELLIOMIMINI

Ornithoschema queenslandense Permkam & Hancock

Material examined. AUSTRALIA: 1 ♂, N Queensland, East Claudie River, Iron Range, 1.i.1996, 20 m, G. & A. Daniels (UQIC); 2 ♀♀, N Queensland, 16°40'S, 145°34'E, 10 km NW Ellis Beach, 20.iv.1997, C.J. Burwell (QMB).

Comments. The host plant of this endemic Australian species remains unknown.

Tribe TRYPETINI

Aciuropsis pusio Hardy

(Fig. 8)

Material examined. AUSTRALIA: 1 ♀, N Queensland, Tully, 21.vi.1939, H.J. Turner (QMB).

Comments. This distinctive, small black species is newly recorded from Australia, being known previously from the Philippines and Papua New Guinea. It is easily recognised by the wing pattern (Fig. 8) and presence of only 2 scutellar setae, the apical pair lacking. *Aciuropsis* Hardy was placed in tribe Trypetini by Han (1999). For a description and further illustrations see Hardy (1987). Host plants are unknown.

***Calosphenisca ndomae* sp. n.**

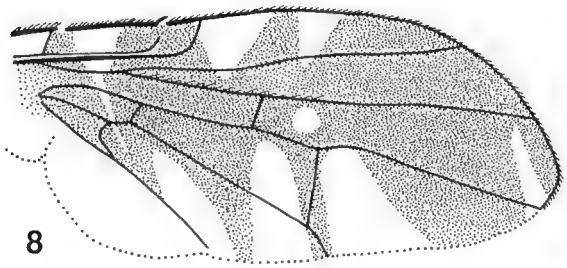
(Fig. 9)

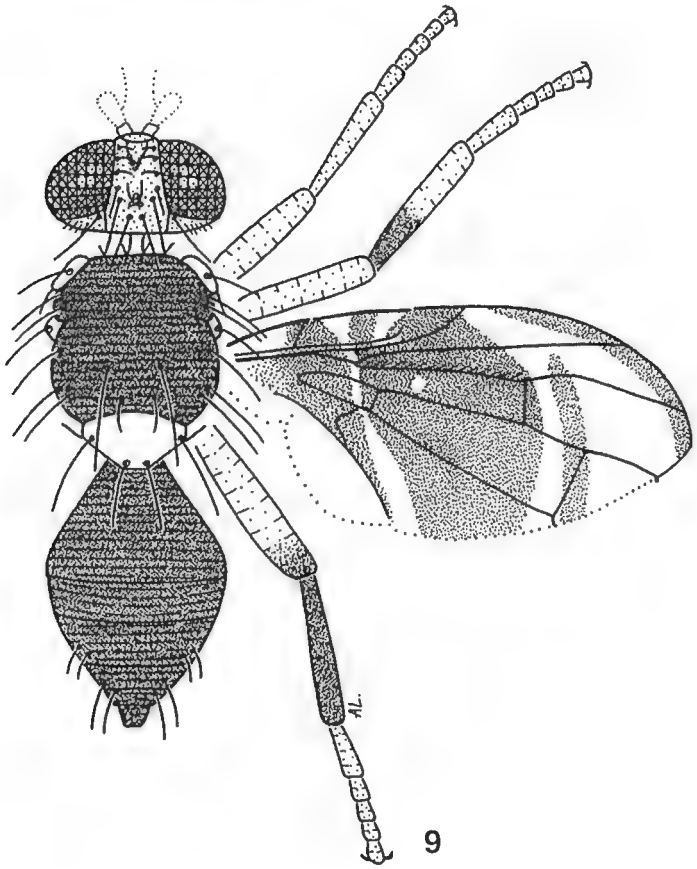
Type. *Holotype* ♀, SOLOMON ISLANDS: NW Guadalcanal, Ndoma, 13.v.1997, R. Hollingsworth, bred ex *Polygata paniculata*, SI 2063 (in QMB, Reg. No. T 99078).

Description. Female (Fig. 9). Length of body (excluding oviscape) 4.6 mm; of wing 4.5 mm. Head higher than long, fulvous except face with greyish sheen and upper occiput red-brown. Antennae yellow; third segment abraded. Frons with a black circular mark medially; 3 pairs of frontal setae and 2 pairs of black orbital setae; ocellars abraded. Postocular row of setae black and thin; genal seta well developed.

Thorax blackish-brown; anepisternum broadly white; scutellum white. Postpronotal lobes dark fulvous to brown; notopleura brown. With a full complement of black setae; dorsocentrals and prescutellar acrostichals present; 1 strong and 1 weak anepisternal setae; 4 scutellars. Haltere with fulvous stalk and white knob. Legs mostly fulvous; hind tibiae fuscous; mid tibia fuscous basally and with an apical black spine.

Wing hyaline with an extensive brown pattern; cell bc hyaline except very pale brown basally and dark brown at apex; cell c brown with 2 hyaline indentations across it; pterostigma brown; a broad basal brown area curved distally from apex of pterostigma to enclose R-M crossvein, intersected by a narrow hyaline band from basal indentation in cell c to wing margin at apex of vein A_1+Cu_2 and with a small hyaline spot in cell br below pterostigma; alula and anal lobe hyaline; a narrow brown costal band from a little beyond apex of pterostigma to wing apex in cell m; an isolated narrow brown band parallel to edge of basal dark area, from just above vein R_{4+5} to wing margin in cell m, enclosing DM-Cu crosvein. Veins R_1 and R_{4+5} setose; R-M crossvein near apex of cell dm, separated from DM-Cu crossvein by about its own length; cell bcu with a narrow and acute apical extension.





Figs 8-9. Trypetini. (8) *Aciuropsis pusio*, wing; (9) *Calosphenisca ndomae* sp. n., female.

Abdomen oval, blackish-brown; tergite VI about as long as tergite V. Oviscape short and conical, as long as tergite VI, 0.4 mm; aculeus not exposed.

Host plant. The holotype was bred from the fruit of *Polygala paniculata* (Polygalaceae).

Distribution. Known only from Guadalcanal, Solomon Islands.

Comments. *C. ndomae* closely resembles *C. bicuneata* (Hardy) from Papua New Guinea. It differs in details of the wing pattern, particularly the costal band, which runs along the costa in cell r_1 in *C. ndomae* and along vein R_{2+3} in *C. bicuneata*, and the isolated subapical band, which is elongate in *C. ndomae* and short (beginning in cell m well below vein R_{4+5}) in *C. bicuneata*. The above host record is the first for the genus.

Calosphenisca unicuneata (Hardy)

Comments. *Fusciludia unicuneata* was transferred to *Calosphenisca* Hendel by Korneyev (1999) and Han (1999), following synonymy of the two genera. This species is widespread in eastern Australia and Papua New Guinea (Permkam and Hancock 1995).

Hemiristina pleomeles Permkam & Hancock

Material examined. SOLOMON ISLANDS: 1 ♀, Guadalcanal, Honiara, 10.viii.1994, R. Wylie *et al.*, bred ex *Diplocyclos palmatus*, SI 0120 (QDPI). VANUATU: 3 ♂♂, 3 ♀♀, Efaté, 27.vii.1995, M. Vagalo, host *Dracaena* sp., V 1434 (QDPI).

Comments. Described from Melville and Stephen Islands in northern Australia (Permkam and Hancock 1995), this species is newly recorded from Solomon Islands and Vanuatu. It was bred from *Dracaena* sp. (Agavaceae) in Vanuatu but the above record from *Diplocyclos palmatus* (Cucurbitaceae) in the Solomon Islands is likely to be an error.

Philophylla conjuncta (de Meijere)

Material examined. SOLOMON ISLANDS: 4 ♂♂, 3 ♀♀, NW Guadalcanal, Kodovele, 19.xii.1996, R. Wylie *et al.*, bred from *Premna serratifolia* (L.), SI 0449; 1 ♂, 2 ♀♀, NE Guadalcanal, Vulelua, 29.xii.1994, R. Wylie *et al.*, SI 0541; 27 ♂♂, 25 ♀♀, E Guadalcanal, Adeade, 11.ii.1997, R. Hollingsworth *et al.*, ex *Premna corymbosa*; 6 ♂♂, 4 ♀♀, same data except 6.v.1997, E. Valenga & R. Hollingsworth, SI 2043; 3 ♂♂, 3 ♀♀, Guadalcanal, Tambea, 13.ii.1997, R. Hollingsworth, bred ex *Premna corymbosa*, SI 1971 (all QDPI).

Comments. The above specimens were bred from the fruit of *Premna corymbosa* and *Pr. serratifolia* (Verbenaceae). Malloch (1939) also recorded the type series of *P. apicifasciata* (Malloch) [a synonym of *P. conjuncta*] from *Premna integrifolia* [a synonym of *Pr. serratifolia*].

Philophylla erebia (Hering)

Material examined. AUSTRALIA: 1 ♂, Central Queensland, 25°01'19"S, 147°57'16"E, Carnarvon Nat. Park, Mt Moffatt section Rangers Station, 740 m, 16-18.xi.1995, D. Yeates (UQIC).

Comments. The above locality is the first from central Queensland for this species.

Philophylla fossata (Fabricius)

Material examined. AUSTRALIA: 1 ♂, N Queensland, Iron Range, West Claudie River, 5.xii.1985, D. Yeates, rainforest, at MV light (UQIC); 2 ♀♀, N Queensland, 16°02'S, 145°27'E, Daintree Nat. Park, Cape Tribulation area, malaise in rainforest opening near Emmagen Creek, 2-4.vi.1997, J. & A. Skevington (UQIC); 1 ♀, Central Queensland, 20°06'S, 147°49'E, Finley Creek, E base of Mt Abbott, 13.iv.1997, C.J. Burwell (QMB).

Comments. The distribution of this widespread species is extended south from Cairns (Permkam and Hancock 1995) to the Bowen district.

Philophylla humeralis (Hendel)

Material examined. AUSTRALIA: 1 ♂, 1 ♀, N Queensland, 18°21'S, 146°20'E, Hinchinbrook I., Sunken Reef Bay, 5 m, 20.iv.1999, S.G. Evans, rainforest (QMB).

Comments. The only previous Australian record for this species is Dunk Island (Hancock 1995), also in northern Queensland.

Philophylla quadrata (Malloch)

Material examined. AUSTRALIA: 1 ♂, N Queensland, Iron Range, West Claudie River, 4.xii.1985, D. Yeates, rainforest (UQIC).

Comments. The above is the second Queensland record for this species, described originally from the Solomon Islands.

Tribe XARNUTINI

Xarnuta confusa Malloch

Material examined. AUSTRALIA: 1 ♀, N Queensland, West Claudie River, 4 km SW road junction, 12°44'S, 143°15'E, 26.xi.1986, G. Daniels & M.A. Schneider (UQIC).

Comments. Often referred to tribe Acanthonevrini (subfamily Phytalmiinae), *Xarnuta* Walker was placed in subfamily Trypetinae, as currently defined, by Hancock (1986) and Korneyev (1999). *X. confusa* appears to be widespread in northern Queensland.

Xarnuta cribralis Hering

Material examined. PAPUA NEW GUINEA: 2 ♂♂, 1 ♀, Central Province, Hall Sound [near Yule Island], McL. (UQIC).

Comments. The female, previously unknown, is similar in appearance to the male.

Acknowledgements

We thank Amy Lawson (Griffith University) for preparing the illustrations and curators of the various institutions for access to material. Field work in Papua New Guinea, Solomon Islands and Vanuatu was carried out under the auspices of ACIAR Project No. CS2/94/03 'Identification of pest fruit flies in Vanuatu, Solomon Islands and Federated States of Micronesia' and the Regional Management of Fruit Flies in the Pacific Project.

References

HAN, H.-Y. 1999. Phylogeny and behavior in flies of the tribe Trypetini (Trypetinae). Pp 253-297, in Aluja, M. and Norrbom, A.L. (eds), *Fruit flies (Tephritidae): phylogeny and evolution of behavior*. CRC Press, Boca Raton; xviii + 944 pp.

HANCOCK, D.L. 1986. Classification of the Trypetinae (Diptera: Tephritidae), with a discussion of the afrotropical fauna. *Journal of the Entomological Society of Southern Africa* **49**: 275-305.

HANCOCK, D.L. 1995. *Philophylla humeralis* (Hendel) (Diptera: Tephritidae: Trypetinae) newly recorded from Australia. *Australian Entomologist* **22**: 113-114.

HANCOCK, D.L. and DREW, R.A.I. 1994. Notes on some Pacific Island Trypetinae and Tephritinae (Diptera: Tephritidae). *Australian Entomologist* **21**: 21-30.

HANCOCK, D.L., HAMACEK, E.L., LLOYD, A.C. and ELSON-HARRIS, M.M. 2000. *The distribution and host plants of fruit flies (Diptera: Tephritidae) in Australia.* Information Series Q199067. Queensland Department of Primary Industries, Brisbane; iv + 75 pp.

HARDY, D.E. 1983. The fruit flies of the tribe Euphrantini of Indonesia, New Guinea, and adjacent islands (Tephritidae: Diptera). *International Journal of Entomology* **25**: 152-205.

HARDY, D.E. 1986. The Adramini of Indonesia, New Guinea and adjacent islands (Diptera: Tephritidae: Trypetinae). *Proceedings of the Hawaiian Entomological Society* **27**: 53-78.

HARDY, D.E. 1987. The Trypetini, Aciurini and Ceratitini of Indonesia, New Guinea and adjacent islands of the Bismarks and Solomons (Diptera: Tephritidae: Trypetinae). *Entomography* **5**: 247-373.

KORNEYEV, V.A. 1999. Phylogenetic relationships among higher groups of Tephritidae. Pp 73-113, in Aluja, M. and Norrbom, A.L. (eds), *Fruit flies (Tephritidae): phylogeny and evolution of behavior*. CRC Press, Boca Raton; xviii + 944 pp.

MALLOCH, J.R. 1939. Solomon Islands Trypetidae. *Annals and Magazine of Natural History* (11) **4**: 228-278, pls x-xi.

PERMKAM, S. and HANCOCK, D.L. 1995. Australian Trypetinae (Diptera: Tephritidae). *Invertebrate Taxonomy* **9**: 1047-1209.

A NEW SPECIES OF *CICADETTA* AMYOT (HEMIPTERA: CICADIDAE) FROM QUEENSLAND, WITH NOTES ON ITS CALLING SONG

LINDSAY W. POPPLE

Entomology Section, Queensland Museum, PO Box 3300, South Brisbane, Qld 4101
(Current address: School of Life Sciences, The University of Queensland, St Lucia, Qld 4072)

Abstract

Cicadetta polita sp. n. is described from the Edungalba, Theodore, Taroom and Glenmorgan districts in southern Queensland. It belongs to a little known species complex distributed throughout inland Queensland. Known adult food plants include weeping myall (*Acacia pendula*) and false sandalwood (*Eremophila mitchellii*). An analysis is given of the moderately fast ticking song, specific to this taxon.

Introduction

A new species of cicada collected in southern Queensland shows broad similarities to some other Australian species currently placed in the genus *Cicadetta* Amyot and it is on this basis that generic placement has been made. Characteristics include a similar body shape (both sexes) and similar genital structures in males. Moulds (1988) discussed the status of *Cicadetta* in Australia and a generic review of the Australian cicada fauna is currently in preparation (Moulds, in prep.).

The new species comprises part of an undescribed species complex that is quite distinct from other members of the genus; however, as the remaining members of this complex are not particularly well known at present, only one species is documented here. Another representative of the complex, referred to as *Cicadetta* sp. H, is illustrated in Popple and Strange (2002).

The type series is located in the following collections: QM – Queensland Museum, Brisbane; LWP – L. W. Popple, Brisbane; AE – A. Ewart, Caloundra; MSM – M. S. Moulds – Sydney; JTM – J. T. St. Leger Moss, Capalaba.

Cicadetta polita sp. n.

(Figs 1-2)

Cicadetta sp. G; Popple and Strange, 2002.

Types. Holotype ♂, QUEENSLAND: Myall Park, 6 km N Glenmorgan, SEQ, 27-28.xii.2001, L. Popple, A. Strange (in Queensland Museum, Reg. no. T 108573). *Paratypes*. 1 ♂, 25°36'S 149°46'E, 6 km N Taroom, 3.iii.1998, C.J. Burwell, S.G. Evans; 1 ♀, 2 km W Glenmorgan, 29.xii.2001, L. Popple, A. Strange (both QM); 3 ♂♂, 3 ♀♀, 2 km W Glenmorgan, 29.xii.2001, L. Popple, A. Strange; (LWP); 3 ♂♂, Brigalow Res. Stn nr Theodore, nr dump, *E. mitchellii*, 19.xii.2000, A. E[wart], 24°49.47'S 149°48.04'E; 2 ♂♂, 2 ♀♀, Brigalow Res. Stn nr Theodore, nr lake, *E[remophila] mitchellii*, 19.xii.2000, A. E[wart], 24°49.42'S 149°47.97'E; 1 ♀, Brigalow Res. Stn nr Theodore,. E. brigalow section, 19.xii.2000, A. E[wart], 24°48.85'S 149°47.48'E; 3 ♂♂, 1 ♀ (damaged), Brigalow Res. Stn nr Theodore, nr

lake, *E. mitchellii*, 20.xii.2000, A. E[wart], 24°49.42'S 149°47.97'E; 1 ♂, 1 ♀, 2 km W Glenmorgan, 29.xii.2001, L. Popple, A. Strange (all AE); 3 ♀♀, 3 km E of Mourangee Hsd, nr Edungalba, 20.xi.1986, E.E. Adams; 1 ♂, 1 ♀, 3 km E of Mourangee Hsd, 5.ii.1983, mainly on sandlewood, E.E. Adams; 8 ♀♀, "Mourangee", nr Edungalba, 5.ii.1983, 18.xii.1983 & 14.xii.1985, on sandlewood, E.E. Adams (all MSM);1 ♂, 1 ♀, 2 km W Glenmorgan, 29.xii.2001, L. Popple, A. Strange (JTM).

Description of male (Fig. 1A). Head largely black; postclypeus shiny, barred black, becoming pale brown towards lateral and posterior margins; black along midline; anteclypeus shiny black, with a pale brown spot immediately posterior to the postclypeus; rostrum medium brown anteriorly, extending into black, pale brown at the apex. Dorsal surface of head shiny black, with pink to red ocelli. Eyes medium-light to dark brown or reddish brown. Antennae black, paler towards the apex; antennal lobes pale.

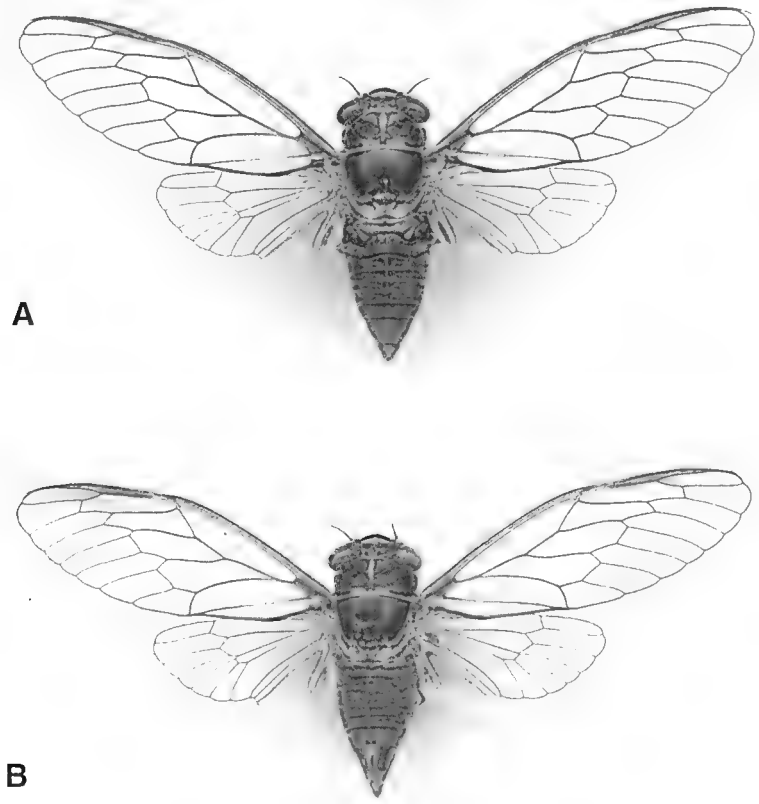


Fig. 1. *Cicadetta polita*. (A) male; (B) female. Approximately 2.4 x life size.

Thorax with pronotum mainly shiny black; prescutum medium brown surrounding midline; midline fascia pale brown to orange, not reaching pronotal collar; pronotal collar pale brown to orange, with colouration extending dorsolaterally either side of midline fascia in the form of two 'wedges'. Mesonotum shiny black with inconspicuous dark brown dorso-lateral and lateral fascia; cruciform elevation and fore wing basal membranes orange-brown. Legs with coxae pale brown with prominent dark brown longitudinal fasciae; femora pale brown with extensive dark brown longitudinal fasciae, pale brown at base and apex; tibiae pale toward base and apex, otherwise medium brown, spines dark brown; tarsi brown, becoming darker brown towards apex of claws.

Wings with forewing costal veins pale brown, becoming darker distally from the node; basal membranes bright orange with a contrasting dark brown spot at the base of the clavus; veins CuA, CuP and the base of M pale brown; all other veins medium brown to dark brown; veins CuA and M fused posterior to apex of basal cell; basal cell noticeably obscured by a thickened CuA vein; with eight apical cells (7 if aberrant). Hindwing with base of vein 1A and much of 2A pale brown; other veins medium brown; plaga pale brown to cream with medium brown median longitudinal fasciae; with six apical cells.

Tymbals (Fig. 2E) with five distinct tymbal ridges present, with three inter-ridge sclerites; dorsal ridge and adjacent ridge comparatively short, not separated by an inter-ridge sclerite, with a separate anterior ridge area; the lower 2-3 ridges joined anteriorly; basal spur present. Opercula (Fig. 2F) follows body axis and broadly sickle-shaped; yellow-brown, becoming darker at anterior of flange; inwardly rounded termination.

Abdomen (Fig 2A) with tergite 2 shiny black, becoming medium brown towards posterior; tergites 3-8 shiny black anteriorly, medium brown distally, with a contrasting orange-brown posterior margin; sometimes with silver pubescence laterally. Sternite 2 orange-brown with dark brown medial fascia that broadens posteriorly; sternites 3 to 6 with prominent dark brown fascia that becomes orange-brown towards anterior and posterior lateral margins; sternite 7 brown to orange-brown, with broad dark brown medial fascia terminating anteriorly; sternite 8 brown, with silver pubescence.

Genitalia (Figs 2B-D). Pygophore rich to pale brown, with darker lobes having a rounded anterior-dorsal termination; uncal lobes prominent, deeply bifurcate and directed ventrally, giving a 'fanged' appearance. Aedeagus trifid with a dark brown anterior-dorsal ridge, prominent dorsal pseudoparameres extending beyond endotheca and ventral pseudoparamere slightly shorter than endotheca; dorsal pseudoparameres dark brown at base, becoming lighter anteriorly and dorsally, transparent at apex; ventral pseudoparamere near black, transparent at apex; endotheca cylindrical and fleshy, pale brown to transparent, becoming darker brown ventrally; gonocoxite IX dark to medium brown with two distinct anterior spurs.

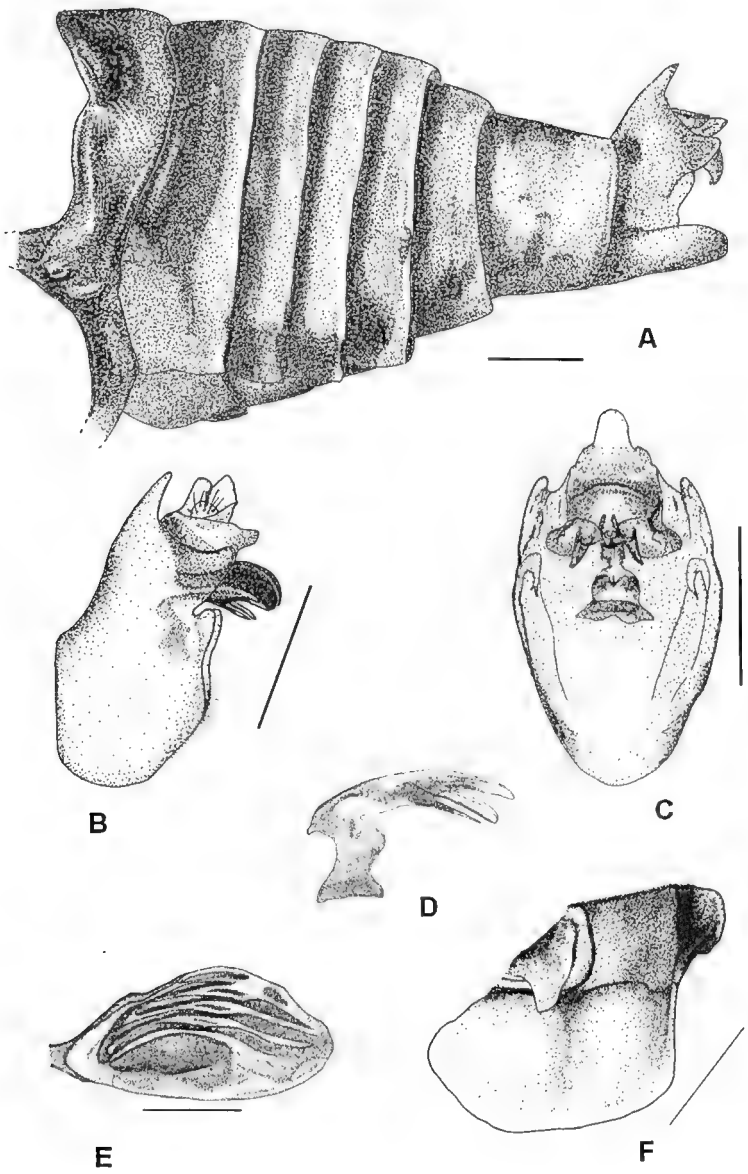


Fig. 2. *Cicadetta polita* male. (A) abdomen, viewed from left; (B) pygophore, viewed laterally from left; (C) pygophore, viewed from posterior ventral side; (D) aedeagus, lateral view of left side; (E) right tymbal; (F) left opercula. Scales = 1 mm.

Female (Fig. 1B). Markings and coloration similar to male. Abdominal segment 9 medium brown, becoming orange-brown towards posterior and ventral region surrounding ovipositor sheath, with a pair of dark brown to shiny black longitudinal dorsolateral fasciae that terminate short of apex; apex dark brown and narrowed sharply into a spine; ovipositor sheath does not extend noticeably beyond termination of abdomen.

Measurements (in mm; range with mean in parentheses: 5 males, 5 females). Body length: male 14.3-14.9 (14.48); female 14.6-16.9 (16.32). Forewing length: male 18.8-19.5 (19.18); female 20.4-22.0 (21.26). Head width: male 4.9-5.0 (4.94); female 5.1-5.3 (5.14). Pronotum width: male 4.3-4.6 (4.44); female 4.6-4.8 (4.68). Abdomen width: male 4.5-4.7 (4.64); female 4.7-4.9 (4.78).

Etymology. *Polita* is the feminine derivative of the Latin *politus*, meaning polished, smooth, refined. This refers to the shiny, polished appearance of the insect.

Comments. *C. polita* can be distinguished from all previously described members of the genus *Cicadetta* by the following two features on the wings: a thickened CuA vein near the base, causing the basal cell to become obscured; and a prominent, dark spot at the base of the clavus. Two undescribed species that are closely related to *C. polita*, both in calling song type and morphology, have been documented under the names *Notopsalta* sp. B (Ewart 1988, 1998, Ewart and Popple 2000, Popple and Strange 2002) and *Cicadetta* sp. H (Popple and Strange 2002). *C. polita* can be distinguished from *Notopsalta* sp. B by the features listed above. *Cicadetta* sp. H has an obscured basal cell and thickened CuA vein like *C. polita*, but lacks the dark spot at the base of the clavus.

Distribution and habitat

Known from localities in the Glenmorgan district near Surat, from 6 km north of Taroom, the DPI Brigalow Research Station near Theodore and the Edungalba district in southern inland Queensland (Fig. 3). In the southern part of its range the preferred adult food plants are weeping myall (*Acacia pendula*) and false sandalwood (*Eremophila mitchellii*), especially where both species occur near riverbeds. Adults have a tendency to sit on the inner and outer branches where they are not particularly mobile, but will take flight if disturbed (Popple and Strange 2002). Near Theodore, almost all specimens were collected from *E. mitchellii* (A. Ewart, pers. comm.).

Calling song

Calling songs were recorded on a Sony MZR700 Minidisk recorder with a digital Sony EC957 Electret Condenser Microphone at the Glenmorgan site (LWP) and on a Sony WM-D6C cassette recorder at Brigalow Research Station, Theodore site (A. Ewart). Oscillograms were generated using Cool Edit and all calling songs were digitised at a 44.1 kHz sampling rate.

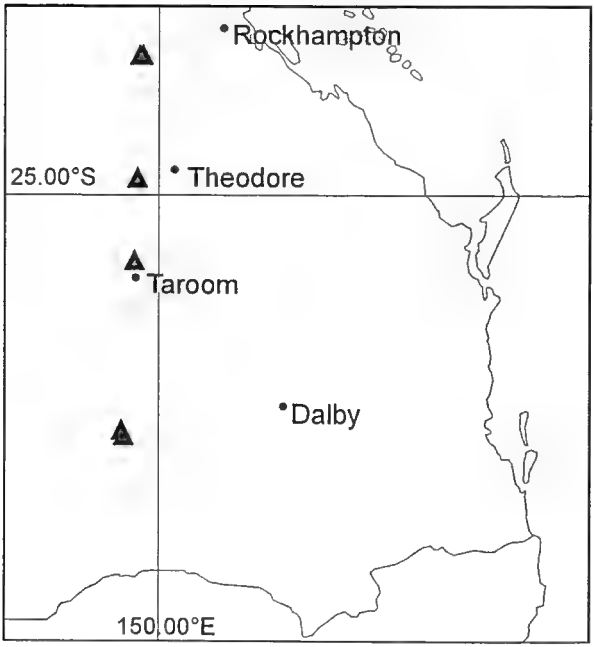


Fig. 3. Distribution of *Cicadetta polita*: localities where specimens in the type series were collected (▲).

Song structure terminology follows Ragge and Reynolds (1998). The song consists of two distinct phases (Fig. 4). Phase one (Figs 4A, 4C) consists of monotonously repeated single phrases or echemes. Each echeme lasts for approx. 0.05 s and there is a distinct 0.20-0.27 s period of silence between each. The second phase (Figs 4B, 4D) is similar, but emitted at a much faster rate. The echemes themselves are not shorter (approx. 0.04-0.06 s), but the gap between echemes is greatly reduced to about equal the length of an individual echeme (0.04-0.06 s). The song usually commences with the first phase, but may alternate freely between the two phases during each song burst. Sequences of each song phase may last for longer than 60 s, depending on the weather conditions and the number of males calling.

The frequency range of the song from the recording at Myall Park, Glenmorgan showed a broad-banded peak from 13-19 kHz with a further superficial peak at 9-10 kHz. The specimen recorded near Theodore had a similar broad peak spanning from 11-17 kHz. The two recordings showed similarities in the extent of the dominant frequencies. Differences may have been attributed to differences in recording equipment and/or processing software.

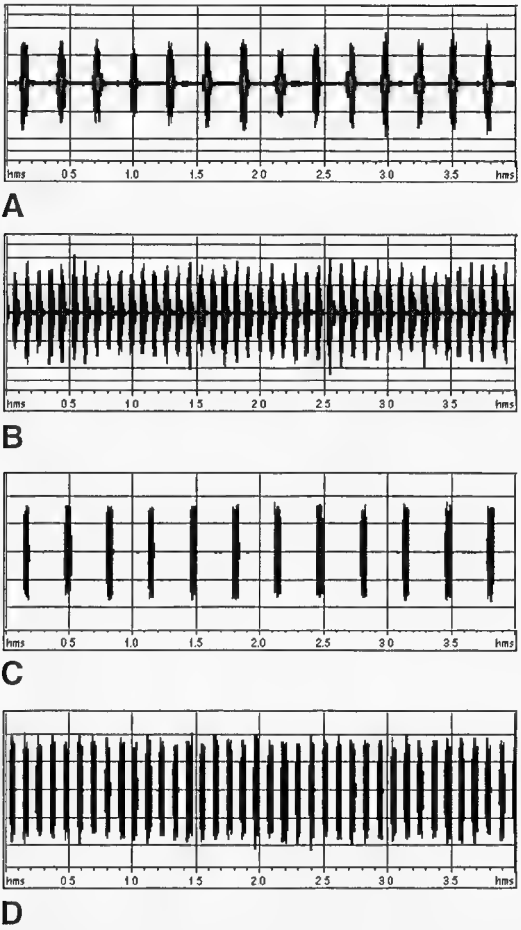


Fig. 4. Calling song of *Cicadetta polita*. (A) phase one of song recorded at Myall Park, Glenmorgan; (B) phase two of song at same location; (C) phase one of song recorded at Brigalow Research Station (A. Ewart); (D) phase two of song at same location (A. Ewart). Each segment has a duration of 4 seconds.

Males sing most vigorously when there is sufficient sunlight during the morning and late afternoon, avoiding the heat in the middle of the day. In overcast weather, singing is sporadic and may occur at any time of day. Singing males have been seen to aggregate in the presence of females.

Notopsalta sp. B has a similar song to *C. polita*, with similar repetitive phrases; however, the echemes themselves are much longer (0.18-0.22 s) and are sporadically interspersed with a short phrase (0.06-0.08 s) followed by a long phrase (0.32-0.34 s) comprising four coupled echemes. The song is

illustrated in Ewart (1988). The dominant frequency range extends from 14-15 kHz (Ewart and Popple 2000).

The calling song of *Cicadetta* sp. H shows a similar broad-band frequency range to *C. polita*. However, the structure of the two songs is entirely different. *Cicadetta* sp. H. produces regular phrases that consist of a closely emitted group of echemes; its song is illustrated in Popple and Strange (2002).

Acknowledgements

I wish to extend deep gratitude to Geoff Thompson for his advice and assistance with scientific illustration. Sincere thanks to Tony Ewart for providing song recordings, discussing the general ecology of the species and for commenting on the manuscript, and Max Moulds for critical comments and for retrieving paratype data from his extensive collection. Also, many thanks are due to Gimme Walter for providing suggestions and for commenting on the initial draft of the manuscript.

References

EWART, A. 1988. Cicadas (Homoptera). Pp 180-201, in Scott, G. (ed.), *Lake Broadwater. The natural history of an inland lake and its environs*. Lake Broadwater Natural History Association and Darling Downs Institute Press; 344 pp.

EWART, A. 1998. Cicadas, and their songs, of the Miles-Chinchilla region. *Queensland Naturalist* **36**(4-6): 54-72.

EWART, A. and POPPLE, L.W. 2001. Cicadas, and their songs, from southwestern Queensland. *Queensland Naturalist* **39**(4-6): 52-71.

MOULDS, M.S. 1988. The status of *Cicadetta* and *Melampsalta* (Homoptera: Cicadidae) in Australia with the description of a new species. *General and Applied Entomology* **20**: 39-48.

MOULDS, M.S. 1990. *Australian cicadas*. New South Wales University Press, Kensington; 217 pp.

POPPLE, L.W. and STRANGE, A.D. 2002. Cicadas, and their songs, from the Tara and Warroo Shires, southern central Queensland. *Queensland Naturalist* **40**(1-3): 15-30.

RAGGE, D.R. and REYNOLDS, W.J. 1998. *The songs of the grasshoppers and crickets of Western Europe*. Harley books, Colchester, in association with The Natural History Museum, London; 591 pp.

A SECOND NEW SPECIES OF *GNATHOTHLIBUS* WALLENGREN (LEPIDOPTERA: SPHINGIDAE) FROM VANUATU

R.B. LACHLAN and M.S. MOULDS

Entomology Department, Australian Museum, 6 College St, Sydney, NSW 2010

Abstract

Gnathothlibus vanuatuensis sp. n. is described from Vanuatu and distinguished from *G. erotus* (Cramer) and the sympatric *G. saccoi* Lachlan & Moulds (= *G. malleti* Schmit).

Introduction

Six species and one subspecies of *Gnathothlibus* Wallengren have been described from the Asia-Pacific region. D'Abrera (1987) recorded *G. erotus erotus* (Cramer) from Sri Lanka east to the Indonesian islands of Sumatra, Java, Borneo and Sulawesi and north to the Philippines. Moulds (1986) recorded it from Christmas Island (Indian Ocean). *G. erotus eras* (Boisduval) is widespread from the Australian region to Tahiti. *G. meeki* (Rothschild & Jordan) and *G. heliodes* (Meyrick) are recorded from New Guinea and *G. brendelli* Hayes from Sulawesi (D'Abrera 1987). *G. dabrera* Eitschberger was also recorded from Sulawesi by Eitschberger (1999). *G. saccoi* Lachlan & Moulds (= *malleti* Schmit (Schmit 2003)) was recorded from Vanuatu by Lachlan and Moulds (2001) and Schmit (2002).

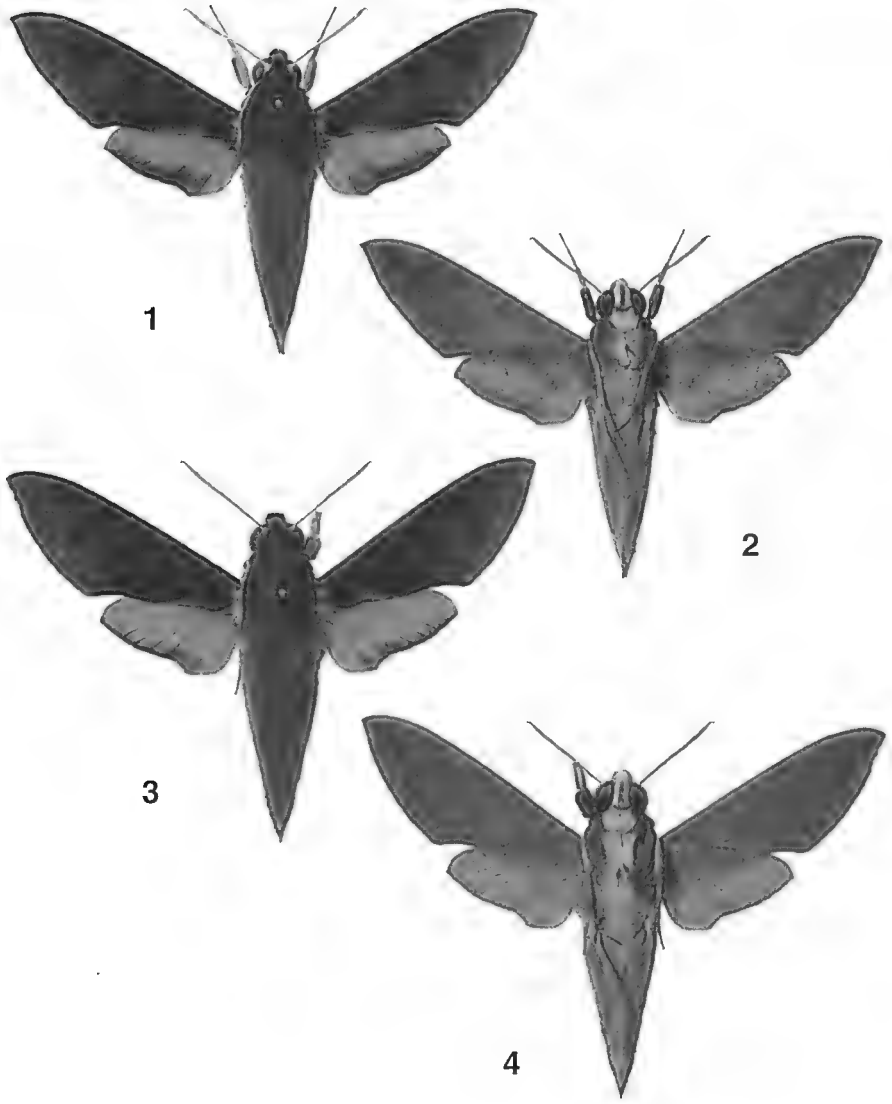
An undescribed species, similar to but clearly different from *G. erotus* (and previously confused with it), was collected in Vanuatu on the islands of Espiritu Santo, Malekula, Ambrym and Tanna during 1987-1989, and 2000. Schmit (2002) also recorded it (as *G. erotus eras*) from Efaté. It is described below. Placement of this new species in *Gnathothlibus* complies with the wing colouration and the generic diagnosis given by D'Abrera (1987).

Gnathothlibus vanuatuensis sp. n.

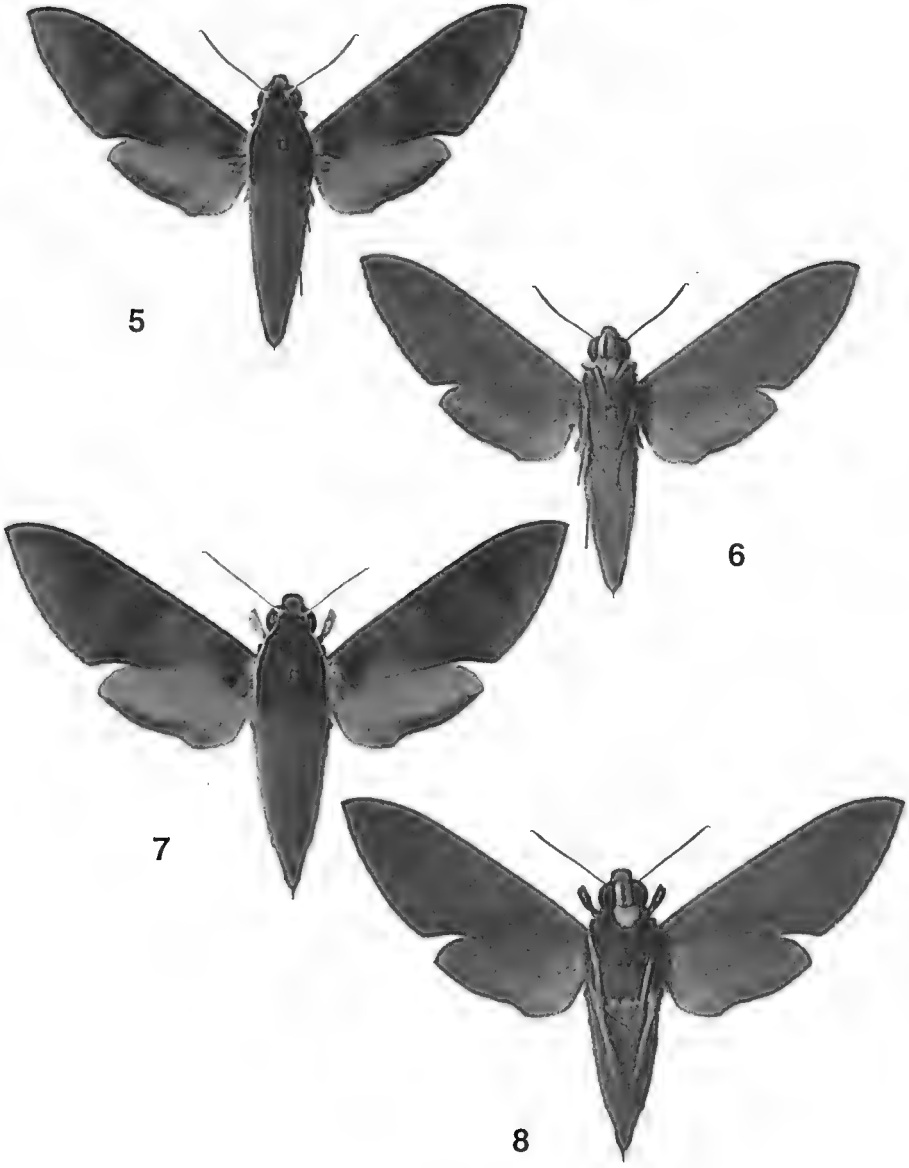
(Figs 1-2, 5-6, 9-10, 13)

Types. Holotype ♂, VANUATU: Lowanatom, Tanna I., 8.xii.2000, R.B. Lachlan (in Australian National Insect Collection, CSIRO, Canberra [ANIC]). *Paratypes*: 2 ♂♂, 3 ♀♀, Port Olry, Espiritu Santo I., 4, 7, 22.i.1988 & 16.i.1989, R.B. Lachlan; 10 ♂♂, 7 ♀♀, Luganville, Espritu Santo I., 15, 21.xii.1987, R.B. Lachlan; 1 ♂, Vao I., 0.5 km off NE coast of Malekula I., 15.i.1989, R.B. Lachlan; 24 ♂♂, 10 ♀♀, Olal Mission area, north Ambrym I., 22.xii.1988, 7, 11.i.1989 & 19, 20, 23-28.ix.1989, R.B. Lachlan; 9 ♂♂, 2 ♀♀, Lowanatom, Tanna I., 4, 5, 8, 9.xii.2000, R.B. Lachlan (in ANIC, Australian Museum, Sydney and RBL collection).

Description. Male (Figs 1-2). Forewing length 37.5-43 mm. Antenna dark creamy-brown above, brown below; palpi dark brown above, contrasting off-white with some dark scales below; dorsal surface of head, thorax and abdomen uniform, medium brown; small dark median spot on prothorax; thin lateral creamy-brown stripe from base of antenna to posterior of thorax. Thorax ventrally with wide creamy-brown patch immediately posterior to palpi, remainder of band suffused heavily with brown to base of metathorax.



Figs 1-4. *Gnathothlibus* spp., males. (1-2) *G. vanuatuensis*, holotype: (1) upperside; (2) underside. (3-4) *G. erotus eras*: (3) upperside; (4) underside.



Figs 5-8. *Gnathothlibus* spp., females. (5-6) *G. vanuatuensis,* paratype: (5) upperside; (6) underside. (7-8) *G. erotus eras*: (7) upperside; (8) underside.

Abdominal segments laterally each with reddish-brown posterior margin contrasting with brown ground colour; abdomen with five small lateral black spots, surrounded by white. Fore tibiae covered in creamy-brown hair scales tinged with pink; fore tarsi without hair scales.

Forewing upperside as in Fig. 1; ground colour brown (slightly deeper olive-brown in fresh specimens) with darker markings; small black stigma with browny-white centre at end of discal cell; irregular lighter brown marginal band from apex to tornus, edged by a slightly curved oblique dark line from apex to vein M_1; a prominent dark, mostly straight, post median line runs from costa, where it is curved slightly distally, to inner margin; a short, irregular, slightly darker subbasal band, curved distally from costa to the dark basal patch below vein 1A+2A, edged on each side by darker, irregular lines. Forewing underside as in Fig. 2; ground colour burnt orange, lighter and without markings basad; speckled with dark brown distally; stigma usually very faint; a dark, straight subterminal line angled inwardly from apex to vein M_2 then irregular to tornus; two dark parallel post median lines from costa to vein CuA_2, the distal line more prominent, these median and post median lines can be fainter and reach only vein R_5 in some specimens.

Hindwing upperside as in Fig. 1; ground colour orange; a slightly variable, dark brown terminal band from apex to tornus at least 2 mm wide at vein M_3, thinnest at apex; inner margin of band irregular and suffused with orange scales. Hindwing underside as in Fig. 2; ground colour light orange-brown; heavily speckled with dark brown; marginal area darker from apex to tornus; dark, mostly straight submedian band, thickest at costa, curving proximad from costa to vein 1A+2A and touching distal edge of cell; a less prominent parallel dark post median band of spots to veins Rs or M_1, in many specimens this line also reaches vein 1A+2A.

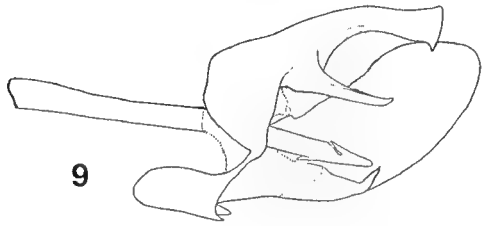
Male genitalia (Figs 9-10). Uncus in lateral view longish slender, parallel sided, gently arched, distally enlarged with small dark ventral tooth and small dorsal crest, distal margin slightly convex; gnathos in lateral view thin, straight, gradually tapering to a small upturned point; in dorsal view gnathos is wide, with a slight incurve at attachment point to tegumen, distally tapering to a point with curved sides; valva gently convex at ventral margin, dorsal margin tending straight then slightly convex, distally rounded; sacculus process robust, distal end dark, spine-like, upturned; aedeagus in lateral view with end tapered to a rounded apex with dorsal backward directed barb, with a smaller ventral barb a little proximad of dorsal barb.

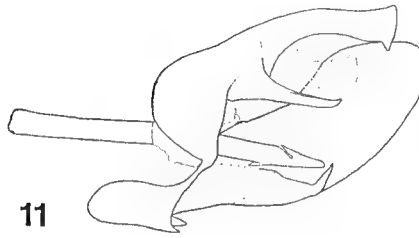
Female (Figs 5-6). Forewing length 39.5-48.8 mm. Head and tegulae dark brown. Median area of thorax and abdomen above uniform medium brown. Abdomen below reddish-brown with contrasting darker brown markings. Fore tibiae as in male, covered in long cream hair scales, suffused with pink on anterior edge and darker at distal end of posterior edge; fore tarsi as in male, without hair scales.

Forewing upperside as in Fig. 5; ground colour and pattern in shades of brown, darker and more prominent than male; small black stigma with light centre at end of discal cell. Forewing underside similar to male but ground colour medium orange-brown, tending pinker along distal edges; stigma not visible; distinctly speckled with dark brown distally, with two dark parallel post median lines from costa to at least vein M_1, often reaching vein CuA_2.

Hindwing upperside similar to male but dark brown terminal band broader, with inner margin fairly straight in most specimens and suffused with orange scales; this band normally terminates at tornus at vein 1A+2A, its inner margin not running basad along this vein further than the brown band along vein CuA_2. Hindwing underside ground colour same as forewing but more heavily speckled with dark brown; yellowish streak along vein 1A+2A.

Female genitalia. Apophyses posteriores long, very slender, minutely enlarged subapically; apophyses anteriores spatulate on distal half, signum very long and narrow, extending full length of corpus bursae and consisting of a pair of closely parallel lines of cornuti.





Figs 9-12. Male genitalia of *Gnathothlibus* spp. (9-10) *G. vanuatuensis* paratype, Tanna I.: (9) genitalia *in situ* but with left valva removed, lateral view; (10) gnathos, dorsal view; (11-12) *G. erotus eras,* Julatten, north Queensland: (11) genitalia *in situ* but with left valva removed, lateral view; (12) gnathos, dorsal view.

Etymology. The specific name *vanuatuensis* is derived from the island nation of Vanuatu, the only known locality for the species.

Distribution. At present *G. vanuatuensis* is known from the islands of Espiritu Santo, Vao (just off Malekula), Ambrym, Efaté and Tanna. Specimens were first collected in December 1987 and January 1988 on Espiritu Santo and subsequently in January and September 1989 on Ambrym and January 1989 on Vao. In December 2000, many specimens were taken on Tanna in southern Vanuatu. Schmit (2002) recorded it from Efaté in April and May.

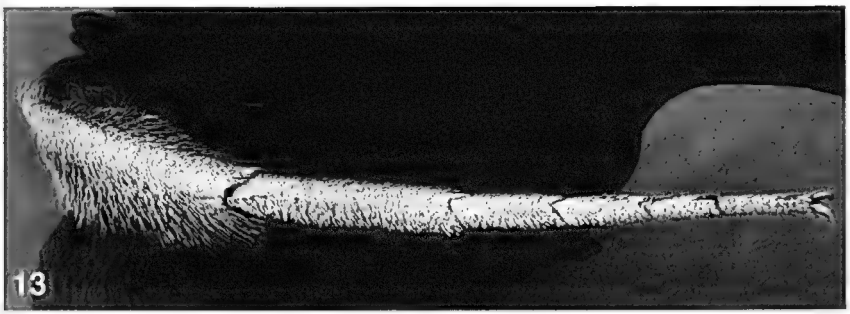
Discussion

Gnathothlibus vanuatuensis most closely resembles *G. erotus eras*, the common subspecies occurring in Australia, Papua New Guinea, Solomon Islands (Tennent 1999) and New Caledonia to Tahiti. *G. vanuatuensis* is readily distinguished from both *G. saccoi* (see Lachlan and Moulds 2001) and *G. erotus eras* (Figs 3-4, 7-8, 11-12, 14) by the complete absence of any long hair scales on the fore tarsi and a clear reduction in length and thickness of the long hair scales covering the fore tibiae in males (Fig. 13).

Both sexes of *G. vanuatuensis* have consistent, more prominent forewing markings than *G. erotus* and in this respect are similar to *G. saccoi*. Clark (1922) described subspecies *G. erotus cramptoni* Clark from Guam based primarily on this character but Kitching and Cadiou (2000) synonymised it because other Pacific Island populations are known to exhibit strong forewing markings.

The forewing stigma on both sexes of *G. vanuatuensis* is more evident than generally seen on *G. erotus*, where it is usually reduced or absent. The males of *G. vanuatensis* are slightly smaller than those of *G. erotus* but females are clearly smaller. The dark brown terminal band on the hindwing of males of *G. vanuatuensis* is wider than in *G. erotus eras*; in females the inner margin of this band does not run basad along vein 1A+2A, as often occurs in *G. erotus eras* females; the median line on forewing upperside, distal of stigma, is straighter and less curved near costa than in *G. erotus*; the oblique band bordered distally by this median line and encasing the stigma is clearly narrower where it reaches the inner margin than in *G. erotus*.

Some specimens of *G. vanuatuensis* exhibit a general greenish tinge on the forewing upperside, as in *G. saccoi,* but this tinge is not seen in *G. erotus*. On the forewing underside of *G. vanuatuensis*, two dark-spotted, median, oblique lines are usually visible from costa to vein M_1, sometimes extending to the termen in heavily marked specimens; these lines are generally vestigial or missing in *G. erotus eras*. On the hindwing underside there is one, often two, oblique, brown, speckled, parallel lines from costa to vein CuA_2, the median line touching the apex of the discal cell; in *G. erotus* these two lines are usually vestigial or missing and clearly distad compared with those of *G. vanuatuensis*.



Figs 13-14. Micrographs of *Gnathothlibus* spp., fore tarsi and tibiae of males showing leg scales. (13) *G. vanuatuensis*; (14) *G. erotus eras.*

The thorax of *G. vanuatuensis* has in males, ventrally, creamy-brown pilosity suffused with brown scales; this is whiter and more extensive towards the abdomen in *G. erotus*.

The male genitalia of *G. vanuatuensis* (Figs 9-10) differ from those of *G. erotus* (Figs 11-12) in lateral view in having a shorter uncus. The posterior margin of the tegumen of *G. vanuatuensis* is straighter and slightly indented as in *G. saccoi* (clearly curved in *G. erotus*). The upper margin of each valva of *G. vanuatuensis* is nearly straight basally with a slight upward curve distally (this curve is much more distinct in *G. erotus*). In dorsal view (Fig. 10) the gnathos of *G. vanuatuensis* is slightly wider with curved edges tapering to a point distally; the incurve at attachment is greater in *G. erotus* and the sides are straighter as they taper to a point (Fig. 12). In *G. saccoi* the apex of the uncus in lateral view is dorsally rounded rather than crested and the sacculus of each valva is much broader (Lachlan and Moulds 2001).

G. saccoi is the only other species of *Gnathothlibus* recorded from Vanuatu. Previous records of *G. erotus eras* from Esperitu Santo, Ambrym and Efaté (Lachlan and Moulds 2001, Schmit 2002) are based on misidentifications of *G. vanuatuensis*.

Acknowledgements

We sincerely thank the late Father Albert Sacco for inviting RBL to stay at his missions at Port Olry on Espiritu Santo, Olal on Ambrym and Lowanatom on Tanna during collecting trips, as well as his companionship over all these years. He passed away on 29 January 2002, aged 81 years. For comments on the manuscript we sincerely thank Dr Ian Common (Honorary Research Fellow, CSIRO, Canberra). For the photographs and scanning electron micrographs we thank Stewart Humphreys and Sue Lindsay respectively (both Australian Museum). We also thank Deborah Lachlan for typing the manuscript.

References

CLARK, B.P. 1922. Twenty-five new Sphingidae. *Proceedings of the New England Zoological Club* **8**: 1-23.

D'ABRERA, B. [1987]. *Sphinidae Mundi, hawk moths of the world. Based on a checklist by Alan Hayes and the collection in the British Museum (Natural History).* E.W. Classey, Faringdon; ix + 226 pp.

EITSCHBERGER, U. 1999. Zwei neue Schwarmerarten von den Insel Sulawesi (Lepidoptera: Sphingidae). *Entomologische Zeitschrift* **109**(5): 182-191.

KITCHING, I.J. and CADIOU, J.-M. 2000. *Hawkmoths of the world. An annotated and illustrated revisionary checklist (Lepitoptera: Sphingidae).* Cornell University Press; viii + 226 pp.

LACHLAN, R.B. and MOULDS, M.S. 2001. A new species of *Gnathothlibus* Wallengren (Lepidoptera: Sphingidae) from Vanuatu. *Australian Entomologist* **28**(4): 123-128.

MOULDS, M.S. 1986. The hawk moths (Lepidoptera: Sphingidae) of Christmas Island, Indian Ocean. *Australian Entomological Magazine* **13**(3-4): 37-40.

SCHMIT, P. 2002. Un nouveau Sphingide de Vanuatu: *Gnathothlibus malleti* n. sp. (Lepidoptera, Sphingidae). *Bulletin de la Société entomologique de France* **107**(5): 525-528.

SCHMIT, P. 2003. Note synonymique sur *Gnathothlibus saccoi* Lachlan & Moulds, 2001, et *G. malleti* Schmit, 2002 (Lep., Sphingidae). *Bulletin de la Société entomologique de France* **108**(2): 156.

TENNENT, W.J. 1999. An annotated checklist of the hawkmoths of the Solomon Islands and Bougainville (Lepidoptera, Sphingidae). *Lambillionea* **99**(1): 7-20, (2): 295-308.

CLARIFICATION OF THE NESTING BEHAVIOUR OF *PODALONIA TYDEI SUSPICIOSA* (SMITH) (HYMENOPTERA: SPHECIDAE) BASED ON FURTHER OBSERVATIONS AT CASTLECLIFF BEACH, NEW ZEALAND

ANTHONY C. HARRIS

Otago Museum, PO Box 6202, Dunedin North, New Zealand

Abstract

Use of plant and dead animal material in the final stages of nest closure in *Podalonia tydei suspiciosa* (Smith) is recorded for 16 out of 17 nests studied. One individual used sand only to close the nest. Females cradled caterpillar prey with the forelegs. Female nesting behaviour, nests and cell size and shape were variable. Nests were made either before or after prey was captured. Nest cells were constructed in dry loose sand. All other sand-nesting solitary wasps nesting in the area constructed nest-cells in firm, moist sand. *Tachysphex nigerrimus* (Smith) (Larridae) competed with *P. t. suspiciosa* for nests, even usurping those of the latter, which it would then extend into firm, slightly moist sand. A number of mistakes in previous publications on the biology of *P. t. suspiciosa* are corrected.

Introduction

Podalonia tydei Fernald has a wide distribution in Southern Europe, Asia, North Africa, Australia and New Zealand, the subspecies *P. t. suspiciosa* (Smith) occurring only in Australia and New Zealand (Bohart and Menke 1976). Single-celled nests, containing one paralysed noctuid caterpillar, are made in loose sand.

Ethological data were summarised by Harris (2001) who, while primarily describing the larva, gave an account of nesting behaviour in *P. t. suspiciosa* on Castlecliff Beach (Wanganui, New Zealand), during late December 2000 to January 2001. In that study, females were not observed to cradle caterpillars, as had previously been observed in the Bay of Plenty (Harris 1994) and plant material was not used in nest closures, as had been reported by McCarthy (1917). Neither were females observed to use a stone to tamp down the nest closure, as had been reported in Australia by Chandler (1926), Bristowe (1971) and Rayment (1935). During the 2000-01 summer, my attention was at times diverted to other solitary wasps being studied and I sometimes interrupted final closure and disguising of the nest in order to more easily extract the prey and egg undamaged. Consequently, some details of final closure were probably missed.

The following summer, I revisited the Castlecliff sand dunes study area daily from 31 December 2001 until 31 January 2002. In this present study, 17 nests were observed until they were provisioned, closed and disguised and 32 prey items were observed being carried by females. Continuous, daily observations for a little over a month resolved some of the puzzling features of previous studies and provided a clear interpretation of the distinctive final closure of the nest.

Methods

Thirty-two individual wasps were followed and 17 burrows were excavated when nesting by the wasp was completed. All observations were recorded in field notebooks 57-60 (currently held by the author). Prey and eggs were placed on top of sand pressed into 35 mm plastic film canisters, which were placed into sealed jars filled with sand. The jars, with a thermometer beside them, were kept at 33-37°C on top of a hot water cylinder in a warming cupboard in a house, as described by Harris (2001). Larvae and prepupae were fixed in van Emden's larval fixative then stored in 75% ethanol.

All observations were made in the area of sand dunes at Castlecliff Beach, Wanganui, New Zealand, described by Harris (2001).

Observations and results

Mating

All matings observed resembled those described by Harris (1994).

Adult feeding

Adults took nectar frequently from flowers of catsear (*Hypochaeris radicata* Linnaeus), sweet alyssum (*Lobularia maritima* (Linnaeus) Desvaux) and cineraria (*Percallis* x *hybrida* R. Nordenstam).

Hunting and prey species

Hunting and prey species were as reported by Harris (1994, 2001). Final instar larvae of *Agrotis innominata* Hudson (Lepidoptera: Noctuidae) were taken and were abundant both in the areas where the wasps were nesting and where they were capturing prey.

Prey capture and paralysis

Prey capture and paralysis resembled that described by Harris (1994, 2001) except that two individuals, after stinging the prey to paralysis, subsequently bit and squeezed the area near the mouthparts and on the underside of the head and prosternum. The wasps may have been crushing the pharyngeal ganglia. One female appeared to feed from the prey's mouthparts, in the manner of a pompilid, but this may have been behaviour associated with crushing the pharyngeal ganglia and was most likely to prevent the caterpillar from disgorging a strong-smelling dark liquid from its mouth.

Prey carriage

In all cases, prey was held supine, facing forward, by the mandibles and cradled with the prothoracic legs, as described by Harris (1994) (Figs 1a-f). This was so for both large and small prey. No individual was observed to carry prey in the manner described by Harris (2001), except for one specimen, briefly, when it attempted to push a very large larva that it temporarily could not move. At that time, all its tarsi were in contact with the ground. During normal transport, mid legs alternately reach forward well beyond the forelegs, which tightly cradle the prey (Figs 1b, c, e, f).

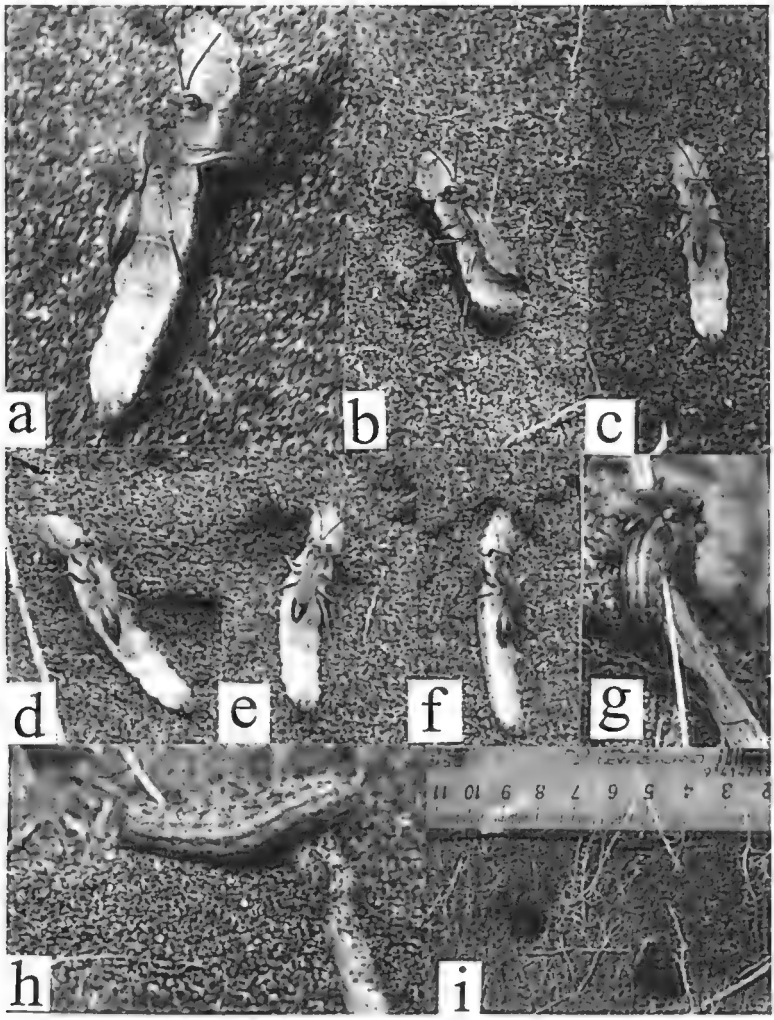


Fig. 1. Prey carriage by *P. t. suspiciosa*: (a), by beating its wings, this individual was able to move a large prey item rapidly; note that the prey is grasped by the mandibles and fore legs; normally, the wings remain folded over the wasp's back; (b), a smaller prey item; note how the wasp's right mid-leg reaches out forward of the fore leg, which grips the prey; (c), large prey carried in the typical manner; (d), prey is gripped by mandibles, forelegs move up to raise prey; (e), mid legs move over fore legs; (f), showing how the wasp balances on its mid and hind legs; (b, c, e & f) show typical prey carriage, cradled by forelegs; (g), positioning prey prone over an aerial root; (h), prey, placed prone over a plant stem, was partly covered with sand, then wasp visited a burrow dug the previous day; (i), two of the five closely-grouped burrows associated with this nest. Scale in mm, applicable only to (i).

Hiding prey
Wasps ran a few centimetres, then hung the caterpillar prone (dorsum up), never supine, over a leaf or a low plant, or over an exposed, horizontal root (Fig. 1g), or placed it under a leaf. When the caterpillar had been hung over a root or stem, some wasps would often turn away from it and kick sand over it with the forelegs, partially covering it with sand (Fig. 1h).

Abandonment of prey
Five paralysed, seemingly suitable prey were abandoned, supine, on warm sand during the study period. A sixth was abandoned when it expired after having being been pushed into an area of intensely hot sand in front of the burrow.

Digging the nest
All nests were shallow, single-celled, dug with both the burrow and the terminal cell completely surrounded by dry, loose, sand. Additional burrows, and "false" burrows were dug as described by Harris (1994, 2001).

One individual dug 2 burrows on 9 January 2002 and a third burrow on 10 January. The wasp then captured and paralysed a final instar *A. innominata* caterpillar, hauled it forward with the mandibles and cradled by the forelegs, supine (venter up), and placed it twice, prone (dorsum up), on a horizontal root. The wasp ran back to the first nest it had made the previous day (9 January), then returned to the caterpillar, turned it supine and commenced dragging it towards this old burrow. It next hid the caterpillar, positioned prone under a leaf, 30 cm from the old burrow, to which it returned and started digging inside it for 13 seconds, presumably preparing a cell for the large prey (33.8 mm long). It then returned to the caterpillar and dragged it supine, head first into the mouth of the burrow and left it with the posterior abdominal segments exposed. The wasp then ran into the burrow under the caterpillar, which disappeared a few seconds later into the burrow.

The main burrow of all 17 nests excavated was 9-10.4 mm wide and 38-86 (mean: 64) mm deep, the cell being 17-56 (mean: 31) mm long. There were 2-6 "false" nests (Fig. 1i) as described by Harris (1994, 2001).

Orientation of prey within the nest
The caterpillar in the nest cell was sometimes coiled on its side in a "C" (sometimes a very loosely-coiled "C"), with the head and anus both facing the entrance. In two nests, the caterpillar was placed in the cell uncurled, supine and straight, with the head facing the end (apex) of the cell and the anus facing the nest entrance; part of the prey in these two nests extended out of the cell and along the main burrow (Figs 2a-d).

Oviposition
The egg (Fig. 3a) was laid laterally on the 2nd, 3rd or 4th abdominal segment. Exceptionally, one individual oviposited on the 1st abdominal segment.

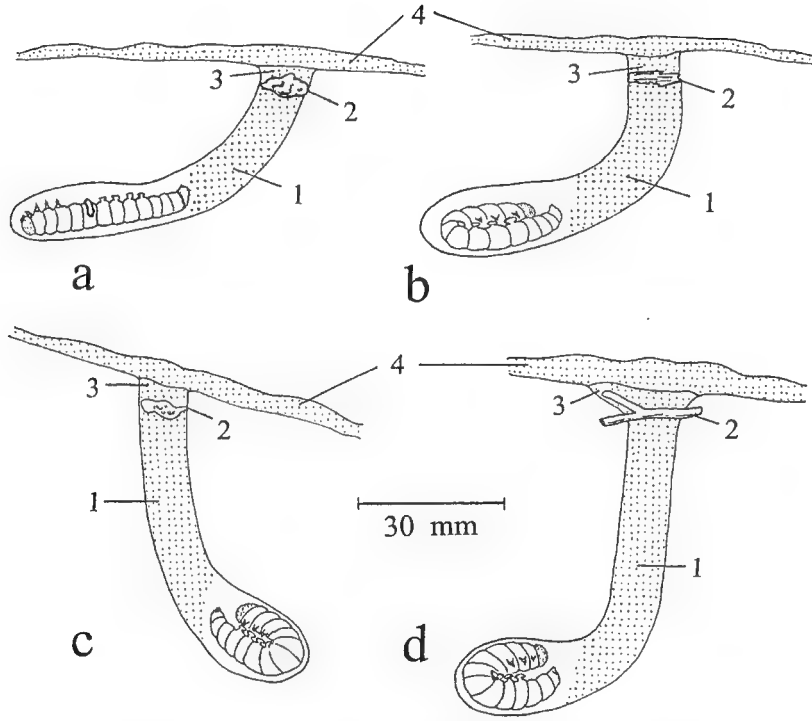


Fig. 2. Four nests of *P. t. suspiciosa* made in loose dry sand at Castlecliff Beach in January, 2002. Note that in (a), the prey is extended straight, whereas it is curled into a "C" in the other nests (b-d). In (d), a forked twig, of which the three points extended outside the diameter of the burrow, was positioned 7 mm below the mouth of the burrow and more sand kicked over that and compacted by the wasp with its frons. *Key to numbers*: 1, Initial sand closure. 2, Fragment of organic material. 3, Final sand closure. 4, Disguising sand kicked over burrow from several directions which camouflages the entrance and is not compacted with the front of the head.

Life history

Of 12 eggs on prey kept at 32-35°C, four subsequent larvae (Figs 3b-c) took six days to finish feeding and begin producing silk. (This constant high temperature is not attained in nature, where development is slower.) Pleural lobes were small in the final larva and large in the prepupa (Fig. 3c).

Nest closure

Between 63 and 76 seconds after entering the nest with the caterpillar (during which time oviposition on the caterpillar occurred), the female ran out 83-89 mm from the main entrance and, facing away from the burrow, kicked sand beneath itself with synchronous thrusts of the forelegs, the gaster being raised as sand passed beneath it then lowered.

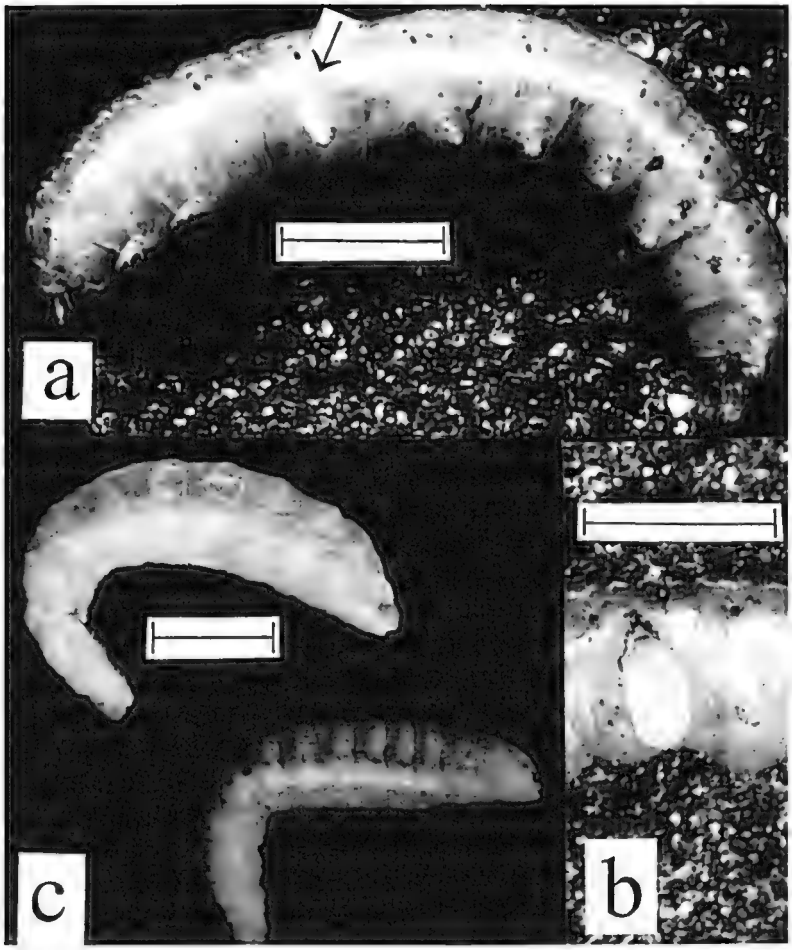


Fig. 3. Life history stages of *P. t. suspiciosa*: (a), egg; (b), first instar larva; (c), two mature larvae. In (c), the top larva has just finished eating its prey; the pleural lobes are small and rounded; the larva at bottom had just started producing its first 5 mm of silk; note that the pleural lobes are much larger. (Photographed 1 day after fixing in van Emden's larval fixative). All scale bars = 4 mm.

The wasp sent sand showering into the burrow for 8-11 seconds, then turned around, ran into the burrow and rammed sand with the front of its head (walking back and forwards, pushing sand with the front of its head and not vibrating its whole body) for about 8 seconds. Then the wasp reappeared, ran about 80 mm from the burrow entrance and, facing out, kicked in more sand beneath itself for about 6 seconds. Then it turned around, ran into the burrow

and rammed sand for about 4 seconds. It alternated between running out and kicking sand into the burrow for 4-16 seconds and turning around and rushing back to pound sand with its frons for 3-5 seconds. It made 8-17 (mean: 9) trips out and back. Each time, after the wasp had finished compacting sand with the front of its head inside the nest, it ran out backwards, pygidium first, the opposite way to a pompilid and many other solitary wasps which run out head first. As it dug, the meso- and metathoracic legs scrabbled to keep balance while the forelegs worked synchronously together, to scoop out sand and send it flying out under the gaster. As each shower of sand grains flew under the wasp, it raised then lowered its gaster, which bobbed continually up and down.

When the sand closure was about 7 mm from the surface, the female invariably ran out and looked for a small piece of dry stem, a leaf or similar organic object and placed it in the mouth of the burrow. It then ran out of the burrow, faced out and kicked in more sand beneath itself, turned around, ran back and compacted the sand with its head. When the sand closure reached the sand surface, the wasp disguised the nest for 77-86 seconds by sending sand showering over the nest from several directions, starting 142-157 mm from the burrow entrance (Fig. 2a-d).

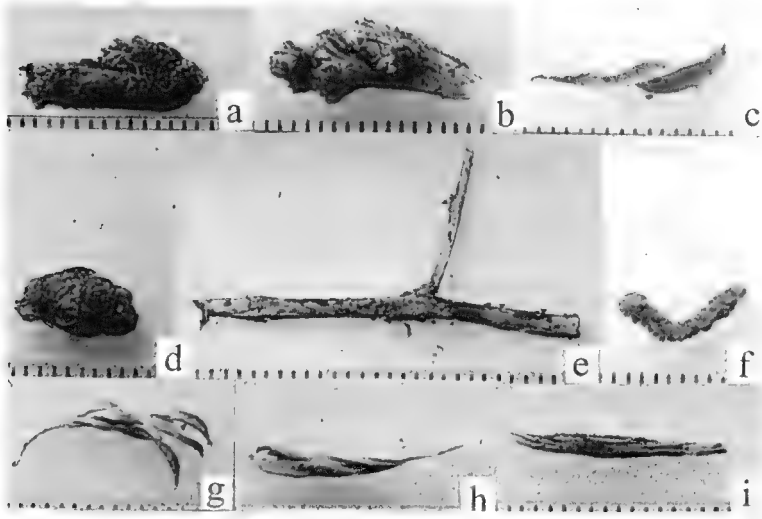


Fig. 4. Single items of organic material (a-i) from each of 9 nests of *P. t. suspiciosa*, positioned about 7 mm below burrow entrance. The wasp that placed item (d) in a nest seemed at first to be compacting soil with it, but inspection with a lens revealed that it was not. The same wasp used a forked twig, item (e), which was much wider than the diameter of the burrow, in its next nest. Items (a, b & d) are roundish wood, (c, g & h) are dried lupin leaflets, (i) is a piece of rotten wood and (f) is a hard, dried, lepidopterous caterpillar. All scales are in mm.

Organic material used in final closure of burrow

Only one individual did not use organic material (Figs 4a-i) to close its burrow. This individual finished closing its nest in light rain, which had caused surface sand to form a crust. The wasp excavated dry sand from beneath the crust and used this to complete its closure to the surface, sand alone being used to fill the nest (nest 17). In all other nests, except for the organic material near the entrance, the entire closure consisted of warm surface sand kicked into the burrow.

One individual, 7 mm below the burrow mouth, held a piece of marram grass rhizome and appeared to be about to ram sand with it (Fig. 4b). Close inspection with a lens revealed that it was, rather, positioning the material. The same female, in her next nest, chose a very thin, long, branching, Y-shaped twig 28 mm long (Fig. 4e). This twig was placed with its central part over the nest burrow, but its three ends were actually outside the nest burrow, so that it could not possibly be used to tamp down sand (Fig. 2d). The wood, moreover, was raised slightly above the sand inside the nest. The wasp ran back, turned away from the nest and kicked sand over the forked twig until it was buried, then tamped down sand with its head. It then ran out 93 mm from the nest and kicked sand over the area from several directions as it disguised the nest. Only one, seemingly token, piece of organic material was used in connection with each of the 16 completed nests observed in January 2002. These objects are listed in Table 1.

Table 1. Characteristics of organic material incorporated in nest closure.

Nest	Object
1	Ovoid marram grass rhizome fragment, 9 x 9 mm
2	Marram grass rhizome fragment, 9 mm x 5 mm (Fig. 4d)
3	Forked twig, 28 mm long (Fig. 4e)
4	Rotten wood fragment, 16 mm x 1.8 mm (Fig. 4i)
5	Dead wood fragment, 13.5 mm x 6 mm (Fig. 4a)
6	Dried, diseased lupin leaf shoot, 14 mm long (Fig. 4g)
7	Dead, dry, hard, *Agrotis innominata* (?) early instar larva, 14 mm long (Fig. 4f)
8	Marram grass rhizome fragment, resembling that in nest 1
9	Lupin leaf fragment, 14 mm long (Fig. 4c)
10	Lupin leaf fragment, 18 mm long (Fig. 4h)
11	Wood fragment, 17 mm x 8.2 mm (Fig. 4b)
12	Marram grass rhizome fragment, 9 mm x 6 mm
13-16	Marram grass rhizome fragment resembling that in nest 2
17	No organic material used; nest filled entirely with dry sand taken from beneath hard, crusted sand after light rain had commenced

Compacting of nest closure without a "tool"
In the burrow entrances, females were not observed to ram by holding a pebble in the mandibles while vibrating the whole body with rapid and audible movement of the flight muscles. It is concluded that, at least on coastal beaches in the Bay of Plenty and at Castlecliff Beach in New Zealand, this species does not use a "tool" to ram nest material. Instead, it drops a piece of dry organic material on the sand of the nest closure about 7 mm from the surface and then puts more sand on top of it.

Variability of nidification cycle
This species sometimes digs its nest before hunting for prey and, at other times, digs its nest after finding prey. In the 2002 observations, no individual was seen to take prey into a succession of burrows before finally ovipositing on the prey, as was recorded by Harris (2001), indicating that this is a variable aspect of nidification behaviour. There were, nevertheless, many variations in the manner in which the paralysed larvae were taken to the nest, including long detours and partial burial of the prey. The unpredictability of which burrow is finally chosen as the nest, together with the placement of organic material within the burrow, about 7 mm below its mouth, possibly make it more difficult for potential predators to locate the immature wasp.

The caterpillar in the nest cell was often coiled on its side (sometimes very loosely) in a "C", with the head and anus both facing the entrance. In two nests, the caterpillar was placed in the cell supine, uncurled and straight, with the head facing the end (apex) of the cell and the anus facing the cell entrance. The egg was placed on the 2nd abdominal segment on both of these non-curled prey. Both nests were very shallow, one being 38.3 mm deep.

Competition
Three *Tachysphex nigerrimus* (Smith) (Larridae) females were observed to drive *P. t. suspiciosa* females from nests. On 7 January 2002, a *P. t. suspiciosa* female spent 38 minutes digging a burrow 63 mm deep, then walked, orienting, around the nest area. As it was doing this, a *T. nigerrimus* female ran into the burrow and remained inside. The *P. t. suspiciosa* female ran into its burrow, ran out, then in and out again twice, after which the *T. nigerrimus* female flew out, rushed at the *P. t. suspiciosa* and drove it away, then re-entered the usurped burrow. The *P. t. suspiciosa* returned, faced away from the burrow and started digging sand into the burrow and ramming it with its head. The *T. nigerrimus* ran out through the sand, flew at the *P. t. suspiciosa,* then began removing sand that the latter had kicked into the burrow. The *T. nigerrimus* female then extended the burrow into firm, slightly damp sand while the *P. t. suspiciosa* began digging a new burrow 14 cm away from its usurped burrow. After 26 seconds, the *P. t. suspiciosa* abandoned her second burrow and ran into the *Acacia longifolia* var. *sophorae* scrub. Two further *T. nigerrimus* females drove *P. t. suspiciosa* females from their burrows but did not nest in the usurped burrows (field notebook 57).

Discussion

Observations made during this and earlier studies are summarised in Table 2. Evan's (1964) assertion that 'all Sphecinae pack the nest closure with blows of the head, while other Sphecidae use the pygidium for this purpose,' is true for *P. t. suspiciosa.* The behaviour seen repeatedly in January 2002 somewhat resembled McCarthy's (1917) brief account of its nidification in Australia, except that New Zealand individuals never used increasingly larger soil particles as they approached the surface, only sand being used, apart from the single item of organic material used about 7 mm from the surface. In all my studies of 1992, 2001 and 2002, no individual rammed sand by holding a small chip in her mandibles 'like a tool', as was described for *P. t. suspiciosa* in Australia by Chandler (1926), Bristowe (1971) and Rayment (1935). When nesting in soil other than marine sand, females may well tamp soil with a chip, but this has not been observed in New Zealand.

Table 2. Summary of observations.

Observations
Prey carriage normally resembles that described by Harris (1994).
Prey is sometimes crushed or lapped around the mouth or oesophagus with the wasp's mandibles and other mouthparts, possibly crushing the host's oesophageal ganglia and imbibing the host's fluids (2 observations).
Prey is caught either before or after construction of the nest.
The prey may be placed in the burrow on its side, curved into a "C", with both head and anus facing the entrance, or (rarely) it may be positioned supine, extended straight, non-curled, with its head facing the end wall (apex) of the cell and with its anus facing the entrance or projecting up the burrow.
The wasp's egg is positioned laterally on the prey, between the 1st and 4th abdominal segment, usually on the 2nd, 3rd or 4th.
Nests are always single-celled.
There are several, very closely-grouped burrows, usually 2-7.
Prey on occasion may seemingly be placed in any one of the 2-7 grouped burrows and, at times, in a nest dug elsewhere.
The entire nest, including both burrow and cell, is completely surrounded by dry, loose sand.
Burrows are filled by sand, kicked by the fore legs below the wasp, facing away from the nest and compacted by ramming with the front of the wasp's head, the wasp alternating between digging and compacting every 3-8 seconds.
During burrow closure, the wasp exits the burrow backwards, pygidium first. Many other solitary wasps, including Pompilidae, exit the burrow head first.
A piece of dry organic matter, varying from a tiny scrap of rotten wood to a twig, a dried leaf, a sprig of dried leaves and a hard, dried, lepidopterous caterpillar, is usually placed in the sand fill of the burrow about 7 mm below the mouth, then more sand is placed on top until the surface is attained, when the nest is disguised.
The nest closure is not tamped down by an object held in the mandibles.

O'Brien (1983) stated that *Podalonia argentifrons* (Cresson), in Arizona, placed a noctuid larva in its burrow not rolled into a "C" shape, but extended out straight, lying on its right side. An egg was placed laterally on the left side between the third thoracic and the first abdominal segments. O'Brien (1983) stated that the non-curled position of the prey might be species-specific to *P. argentifrons*, because 'so far as is known, all cutworms stored by *Podalonia* Fernald species are curled in a "C" shape.' However, my observations of March 1992 and January 2002 indicate that *P. t. suspiciosa* occasionally also places prey in the burrow in an extended, non-curved position, often when it has an exceptionally large prey item, at which times the prey may extend out of the cell and into the burrow.

Evans (1987) stated that *Podalonia occidentalis* Murray was 'unusually variable' in many aspects of its behaviour. Thus nests and prey were both sometimes aborted, some nests were filled with quarries and others lacked quarries (a quarry being an auxiliary burrow dug near the nest for the purpose of obtaining spoil to close the nest burrow). Egg position also varied considerably. The most striking variation in *P. occidentalis* was in the nest-prey dichotomy, this behavioural difference often being considered a fundamental one (Evans 1987). Most reported accounts of *Podalonia* species (and many other more generalised wasps) take prey before they make a nest. In contrast, more derived or specialised wasps (e.g. *Ammophila* W. Kirby) take prey only after they have made a nest (Evans and West-Eberhard 1970, O'Neil 2001, Iwata 1942, 1976).

Evans (1987) stated that an unusual amount of variation in nesting behaviour has been reported in at least two other species of *Podalonia.* He stated that *P. valida* (Cresson) is distinctive in that females make a series of nests in a restricted territory that is defended against intrusion by other females and there was evidence that *P. occidentalis* females return again and again to the same general area to nest, without exhibiting territorial behaviour. In my 2002 observations, *P. t. suspiciosa* behaved on occasions like *P. occidentalis* and *P. valida,* returning to the same general area to nest (always without territorial behaviour). It usually made a series of tightly grouped false burrows.

In 2002, *P. t. suspiciosa* females were thrice observed to be driven from burrows they had dug by the smaller *Tachysphex nigerrimus* females, which then usurped the burrows, either modifying them for their own use or subsequently abandoning them. *P. t. suspiciosa* females at Castlecliff Beach were not limited by scarce nesting space. It is possible that *P. t. suspiciosa* females would compete inter-specifically for nesting territory if they were restricted, in the same way that females of the pompilid wasp *Priocnemis (Trichocurgus) conformis* Smith fight ferociously for nesting space on Leith Saddle, Dunedin, where nesting space is limited. In my experience, this occurs nowhere else, at least not to the same extent (Harris 1999).

Evans (1987) stated that *Podalonia* appears to be a genus in transition, with respect to whether the prey is taken before nest building or after the nest is built. Similarly, O'Neill (2001) stated that it is uncertain whether *Podalonia* species represent primitive forms in the evolution of sphecid nesting behaviour, or whether they have secondarily reverted to a primitive form of nesting (a change in the nesting hierarchy from stage 4a, nest-prey-egg-closure, to stage 3, prey-nest-egg-closure). Nesting cycles are represented by formulae, arranged in an hierarchy that may represent an evolutionary sequence of behaviour (e.g. Harris 1987, 1994, 1999). The second of O'Neil's (2001) alternatives appears to best fit the behaviour of *P. t. suspiciosa* in New Zealand. O'Neil (2001) further suggested that *Podalonia* species may change from stage 3 to stage 4a, depending on prey availability, but this certainly did not apply at Castlecliff Beach where the prey, *Agrotis innominata* final instar larvae, were at all times abundant in the study area.

Acknowledgements

I am very grateful to Mrs E.C. Harris for assistance with all aspects of this work and Mr A.W. Don and Ms A. Jul for commenting on an earlier draft of the manuscript.

References

BOHART, R.M. and MENKE, A.S. 1976. *Sphecid wasps of the world: a generic revision.* University of California Press, Berkeley; 695 pp.

BRISTOWE, W.S. 1971. The habits of a West Australian sphecid wasp. *Entomologist* **104**: 42-44.

CHANDLER, L.G. 1926. Habits of the sand-wasp. *Victorian Naturalist* **42**: 107-114.

EVANS, H.E. 1964. The classification and evolution of digger wasps as suggested by larval characters (Hymenoptera: Sphecoidea). *Entomological News* **9**(75): 225-237.

EVANS, H.E. 1987. Observations on the prey and nests of *Podalonia occidentalis* Murray (Hymenoptera: Sphecidae). *Pan-Pacific Entomologist* **63**(2): 130-134.

EVANS, H.E. and WEST-EBERHARD, M.J. 1970. *The wasps*. University of Michigan Press, Ann Arbor; 265 pp.

HARRIS, A.C. 1987. Pompilidae (Insecta: Hymenoptera). *Fauna of New Zealand* **12**. Department of Scientific & Industrial Research, Wellington; 154 pp.

HARRIS, A.C. 1994. Sphecidae (Insecta: Hymenoptera). *Fauna of New Zealand* **32**. Landcare Research, Lincoln; 111 pp.

HARRIS, A.C. 1999. The life histories and nesting behaviour of the Pompilidae (Hymenoptera) in New Zealand: a comparative study. *Species Diversity* **4**(1): 143-235.

HARRIS, A.C. 2001. Nesting behaviour of *Podalonia tydei suspiciosa* (Smith) (Hymenoptera: Apoidea: Sphecidae: Sphecinae) at Castlecliff Beach, Wanganui, with a description of the mature larva. *New Zealand Entomologist* **24**: 57-62.

IWATA, K. 1942. Comparative studies on the habits of solitary wasps. *Tenthredo* **4**: 1-146.

IWATA, K. 1976. *Evolution of instinct: comparative ethology of Hymenoptera.* Amerind Publishing Co., New Delhi; 535 pp. (Translation of 1971 Japanese edition).

McCARTHY, T. 1917. Some observations on solitary wasps at Hay, N.S.W. *Australian Naturalist* **3**(15): 195-200.

O'BRIEN, M.F. 1983. Observations on the nesting of *Podalonia argentifrons. The Southwest Entomologist* **8**(3): 194-197.

O'NEILL, K.M. 2001. *Solitary wasps, behaviour and natural history.* Comstock Publishing Associates, Cornell University Press, Ithaca; 406 pp.

RAYMENT, T. 1935. *A cluster of bees.* The Endeavour Press, Sydney; 750 pp.

FIELD OBSERVATIONS ON THE LIFE HISTORY AND BEHAVIOUR OF *JALMENUS EVAGORAS EUBULUS* MISKIN (LEPIDOPTERA: LYCAENIDAE) IN THE SOUTHERN BRIGALOW BELT OF QUEENSLAND

M.J. BREITFUSS[1] and C.J. HILL[2]

[1]*Queensland Institute of Medical Research, 300 Herston Rd., Herston, Qld 4029*

[2]*Environmental Protection Agency, PO Box 731, Hume Street, Toowoomba, Qld 4350*

Abstract

Observations on the life history and behaviour of *Jalmenus evagoras eubulus* Miskin are described from an undisturbed forest in the southern brigalow belt of Queensland, supporting the larval host plant *Acacia harpophylla* F. Muell. ex Benth. (brigalow).

Introduction

The butterfly *Jalmenus evagoras eubulus* Miskin is one of two recognised subspecies of *J. evagoras* (Donovan) (Braby 2000). Unlike *J. e. evagoras*, which is distributed along the eastern coast and inland from Melbourne to just north of Gladstone (Common and Waterhouse 1981), *J. e. eubulus* inhabits brigalow-dominated forests and woodlands from central and southern inland Queensland to far northern New South Wales (Common and Waterhouse 1981). Under Queensland legislation, *J. e. eubulus* is considered vulnerable (State of Queensland 1994).

The main aims of this study were to verify the morphology of immature *J. e. eubulus* and to provide *in situ* descriptions of its breeding behaviour, myrmecophilous interactions and larval host preference.

Study site

Field observations were made on a previously unrecorded population of *J. e. eubulus* in a remnant patch of old growth brigalow on the eastern Darling Downs, SE Qld. All observations were made during the peak reproductive period from January to March 1999. The site is located approximately 130 km west of Toowoomba (AMG 304450E 6981000N) and exhibits a characteristic melonhole microtopography on an alluvial substrate.

Acacia harpophylla (brigalow) dominated both the tree and shrub canopies and was infrequently associated with *Eucalyptus populnea* (poplar box), *Santalum lanceolatum* (sandalwood) and *Casuarina cristata* (belah). Small shrub and herb layers comprised sparse covers of *Prostanthera* sp. (native mint), *Enchylaena tomentosa* (ruby saltbush), *Sclerolaena tetracuspis* (brigalow bur), *Commelina* sp. and *Portulaca* sp. Grass cover was dominated by *Panicum decompositum* (native millet).

Description of immature and adult stages

Egg. Similar to those of *J. evagoras* as described by Common and Waterhouse (1981) and Braby (2000). Eggs are bluish-white in colour, with a course pattern of ridges and short spines on the outer surface, radiating from a

darkened micropylar depression. Clusters of 6-15 eggs and/or choria were observed on the stem nodes, stem scars and stem axils of brigalow. No eggs were noted on leaves. Despite lengthy searching, no egg clusters were observed on other vegetation species within the study site.

First instar larva. Colour pink to pale orange dorsally; few pale hairs on dorsal surface; head, prothoracic and anal plates dark brown.

Second to final instar larvae. Colour dark brown to black in mature specimens; paired dark green, brown or black dorsal tubercules on mesothorax, metathorax and abdomen, more conspicuous in mature forms; often with light to shining green, yellow or red subspiracular band; pale, fine marginal hairs; head black; white or cream median line on black prothoracic plate; abdominal segments 7-9 somewhat flattened, gland on seventh abdominal segment conspicuous green or green-yellow; anal plate with minute pale hairs; posterior abdominal segments (7-10) often bordered by a green or yellow subspiracular band; ventral surface pale; thoracic legs dark brown to black, prolegs pale.

Pupa. Glossy dark brown to black; segments, veins, spiracles and often appendages defined by conspicuous orange or light brown bands. Girdle present.

Adult. All adult *J. e. eubulus* observed were similar to nominate *J. e. evagoras*, except for subtle differences in their central wing colouration and banding on the undersides of the wings. *J. e. eubulus* adults had very pale whitish blue- or green-tinted wings with narrow black bands beneath. In comparison, *J. e. evagoras* adults had metallic bluish-green colours on the wings with broad black bands beneath.

Adult behaviour

Adult flight activity in *J. e. eubulus* increased from mid-morning and remained constant throughout the afternoon until dusk, at which time it reduced rapidly. Both males and females were observed in flight and at rest on mature brigalow trees, shrubs and juvenile plants of heights between 0.5 and 17 m. Males were often seen resting in overhanging vegetation above host plants. Adult emergence occurred in the early morning between 0900 and 1000 h and males were regularly observed in flight or at rest close to other pupae.

Copulation in *J. e. eubulus* was observed on four occasions at the study site. Prior to mating a single male or group of males circled a female (which was stationary on the host plant) before landing next to her (within 5 cm). A receptive female responded with wing fluttering and slow spins and then by exposing her abdomen to the successful male.

Copulatory behaviour appeared similar to that in *J. e. evagoras*, with the male extending its genitalia along the length of the female abdomen before

engaging and assuming a tail-to-tail position. Pairs remained *in-copula* for up to 35 minutes, although periods of over 3 h have been recorded for *J. e. evagoras* (Pierce and Nash 1993), and were stationary on the host plant for the duration. All mating observed was between 1030 and 1330 h, although courtship behaviour was noted before and after these times.

Some females were mated directly after eclosion and often before the wings had fully expanded and dried. An extreme case was noted where a female was mated even before releasing the meconium. Upon discharge of the liquid, males flying in the vicinity became very active and attempted to engage the female who, in response, held her abdomen in a slightly upright position. The group of males dispersed soon after and no further mating in the described female was noted.

At 1500 h on the same day, a female with a noticeably swollen abdomen landed on a host plant and appeared to actively search sections of leaves and stems using extended tarsi. This behaviour continued for approximately three minutes before she began laying eggs in a stem axil.

The oviposition site was 30 cm above ground on a juvenile brigalow 1.2 m high. Three similar oviposition locations (two stem nodes and a stem scar each at 0.3 to 0.5 m above ground) were selected on the same plant by the female described above. Host plants selected for oviposition had the attendant ant present, or remnants of the previous season's exuviae. This has also been noted for *J. e. evagoras* (Pierce & Nash 1999).

Males were regularly involved in territorial disputes with other *J. e. eubulus* males as well as different butterfly species (including *Papilio aegeus* Donovan and *Belenois java* L.), birds and humans. As with *J. e. evagoras,* this behaviour was often followed by the defending male returning to a rest position above the host plants which contained immatures. The activity also appeared to be damaging to the males, causing deterioration of the wings over a period of time, similar to that reported for *J. e. evagoras* (Pierce and Nash 1999).

Larval behaviour

Larvae sheltered on the undersides of stems, leaf petioles and leaves at night and in the early morning. During the day, early and late instar larvae fed on mature leaves, growing leaf tips and fresh shoots of juvenile brigalow plants up to 5.0 m in height. Feeding continued until dusk. Unlike *J. e. evagoras*, which congregate into feeding clusters, *J. e. eubulus* were solitary when feeding and clustered after dusk.

Larval feeding sites on the host plant included fresh growth at both ground level (off the main stem) and on the apical meristems of crowns. Food plants with larvae present were often conspicuously defoliated.

Pupation occurred solitarily on brigalow host leaves at heights up to 5.0 m.

Both larvae and pupae were always attended by a small, fast-moving species of *Iridomyrmex* ant (Common and Waterhouse 1981), most likely in the *anceps* group (R. Eastwood, pers. comm.) which attends *J. e. evagoras* (Pierce and Nash 1999). The relationship between the ant and the immature stages of *J. e. evagoras* is mutualistic (Pierce *et al.* 1987, Pierce and Nash 1999) and may be similar for *J. e. eubulus*.

Acknowledgements

The authors thank J. Kerr for sharing his knowledge of this species and its habits and H. Proctor for comments on the manuscript.

References

BRABY, M.F. 2000. *Butterflies of Australia: their identification, biology and distribution*. 2 vols. CSIRO Publishing, Melbourne; xx + 976 pp.

COMMON, I.F.B. and WATERHOUSE, D.F. 1981. *Butterflies of Australia*. Revised Edition. Angus and Robertson, Sydney; xiv + 682 pp.

PIERCE, N. and NASH, D. 1999. The Imperial Blue, *Jalmenus evagoras* (Lycaenidae). Pp 279-315, in Kitching, R., Scheermeyer, E., Jones, R. and Pierce, N. (eds.), *Biology of Australian butterflies*. Monographs on Australian Lepidoptera, Volume 6. CSIRO Publishing, Melbourne; 395 pp.

PIERCE, N., KITCHING, R., BUCKLEY, R., TAYLOR, M. and BENBOW, K. 1987. The costs and benefits of cooperation between the Australian lycaenid butterfly, *Jalmenus evagoras*, and its attendant ants. *Behavioural Ecology and Sociobiology* **21**: 237-248.

STATE OF QUEENSLAND. 1994. *Nature Conservation (Wildlife) Regulation 1994*. SL No. 474. Reprint number 1, Government Printer; 106 pp.

THE LIFE HISTORY OF *TOXIDIA INORNATA INORNATA* (BUTLER) (LEPIDOPTERA: HESPERIIDAE: TRAPEZITINAE)

G.A. WOOD[1] and C.J. MÜLLER[2]

[1]*PO Box 122, Atherton, Qld 4883*

[2]*PO Box 3228, Dural. NSW 2158*

Abstract

The early stages of *Toxidia inornata inornata* (Butler) are described. The larval food plant at Iron Range is an unidentified species of wire grass, *Tetrarrhena* sp. (Poaceae).

Introduction

Toxidia inornata inornata (Butler) occurs in the Kai and Aru Is of Indonesia and in northern Queensland, Australia (Braby 2000). Known Queensland localities are all in Cape York Peninsula: Jardine River basin (Moulds and D'Apice 1982), Captain Billy Creek (Monteith and Hancock 1977), Iron Range (Kerr 1966) and McIlwraith Range near Coen (Eastwood 1995).

At Iron Range, a female was observed depositing a single egg on the leaf of a climber (Matchbox Bean, *Entada phaseoloides*: Fabaceae). This vine was trailing through grass beside a track in rainforest. The egg and piece of vine were collected but, as this seemed an unlikely larval food plant, samples of the grasses growing in the immediate vicinity were also collected. On hatching, the larva left the vine and fed on a wire grass. Females subsequently collected and sleeved with this grass oviposited readily.

Life history

Larval food plant. Wire grass, *Tetrarrhena* sp. (Poaceae).

Egg. Diameter 0.5 mm. Green; dome-shaped, with barely discernible vertical ribs.

First instar larva. Length 3 mm. Head shiny black; round and smooth. Body green; smooth and finely haired.

Final instar larva (Fig. 1). Length 21 mm. Head shiny black with two pale white lateral markings; rounded with very shallow dorsal groove; smooth but finely pitted. Body smooth; translucent green with a reddish tinge that is palest at the centre and darker towards the ends, with prominent whitish dorsal and dorsolateral lines and an indistinct lateral line.

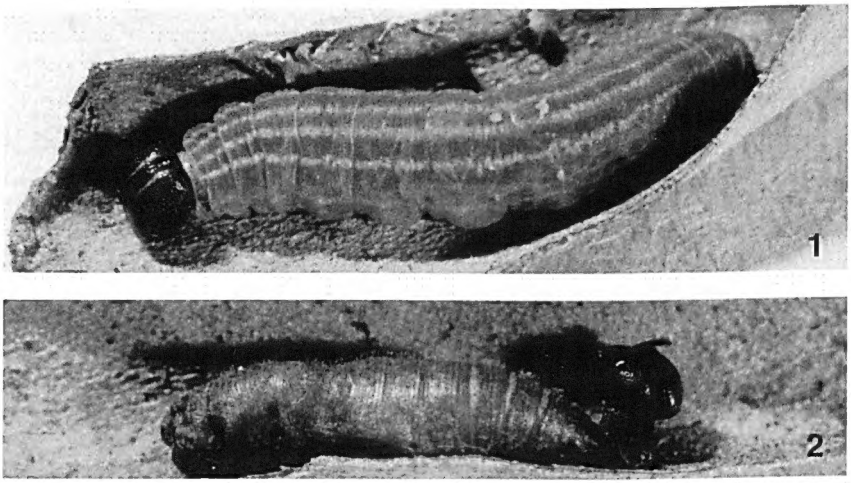
Pupa (Fig. 2). Length 14 mm. Uniformly pale brown; smooth and shiny except wing cases covered with short setae; sculpturing unremarkable; frons rounded; thoracic spiracles black. Attached by cremaster to silken pad.

Discussion

Eggs are laid singly either on the food plant or on nearby material. In captivity, early instar larvae rested on the upper leaf surface of the food plant, rarely producing shelters. When shelters were constructed they were very

rudimentary, consisting of fine silken threads partially folding in the leaf margins. Later instars shelter in debris at the base of the food plant. They were not observed to produce shelters but utilised naturally occurring rounded leaves or bark in which to rest or pupate. In Figure 2, a section of the bark has been removed to expose the pupa.

Toxidia inornata inornata is a rainforest species that usually flies close to the ground. It occurs throughout the year but is most common after the wet season when wire grass is at maximum growth. Eggs laid in mid September produced adults in mid January. Pupal duration was 12 days.



Figs 1-2. *Toxidia inornata inornata.* (1) final instar larva; (2) pupa.

Acknowledgement

We are grateful to the Queensland Parks and Wildlife Service for the permit covering this work.

References

BRABY, M.F. 2000. *Butterflies of Australia: their identification, biology and distribution.* 2 vols. CSIRO Publishing, Melbourne; xx + 976 pp.

EASTWOOD, R.G. 1995. New distribution records of Hesperiidae and Lycaenidae. *Australian Entomologist* **22**: 75-76.

KERR, J.F.R. 1966. New records of Lepidoptera in Australia. *Journal of the Entomological Society of Queensland* **5**: 72-73.

MONTEITH, G.B. and HANCOCK, D.L. 1977. Range extensions and notable records for butterflies of Cape York Peninsula, Australia. *Australian Entomological Magazine* **4**: 21-38.

MOULDS, M.S. and D'APICE, J.W.C. 1982. Butterflies of the upper Jardine River, Cape York Peninsula. *Australian Entomological Magazine* **9**: 21-26.

ENTOMOLOGICAL NOTICES

Items for insertion should be sent to the editor who reserves the right to alter, reject or charge for notices.

WANTED. Specific butterfly collection data for inclusion in a planned systematic list of the butterflies of Micronesia, Melanesia and Polynesia plus the Bismarck Archipelago. Even common butterflies with reliable island data are valuable. John Tennent, 38 Colin McLean Road, Dereham, Norfolk NR19 2RY, England (e-mail jt@storment.freeserve.co.uk).

NOTES FOR AUTHORS

Manuscripts submitted for publication should, preferably, be type-written, double spaced and in triplicate. Refer to recent issues for layout and style.
All papers will be forwarded to two referees and the editor reserves the right to reject any paper considered unsuitable.

Papers longer than ten printed pages will normally not be accepted.

Papers will be accepted only if a minimum of 100 reprints is purchased. Manuscripts occupying less than one printed page may be accepted without charge if no reprints are required. Charges are as follows: cost per printed page $27.50 (B&W), $60 (colour) for 100 copies. Page charges may be reduced at the discretion of the Publications Committee.

Illustrations. Both colour and B&W photographs must be submitted at the size they are to appear in the journal. Line drawings should be about twice their required size.

Address manuscripts to: The Editor
The Australian Entomologist
P.O. Box 537,
Indooroopilly, Qld, 4068
Australia

Printed by ColourWise Reproductions, 300 Ann Street, Brisbane, 4000.

THE AUSTRALIAN
Entomologist
Volume 30, Part 3, 30 September 2003

CONTENTS

BREITFUSS, M.J. AND HILL, C.J.
Field observations on the life history and behaviour of *Jalmenus evagoras eubulus* Miskin (Lepidoptera: Lycaenidae) in the southern brigalow belt of Queensland. 135

HANCOCK, D.L. AND DREW, R.A.I.
New species and records of Trypetinae (Diptera: Tephritidae) from Australia and the South Pacific. 93

HARRIS, A.C.
Clarification of the nesting behaviour of *Podalonia tydei suspiciosa* (Smith) (Hymenoptera: Sphecidae) based on further observations at Castlecliff Beach, New Zealand. 123

LACHLAN, R.B. AND MOULDS, M.S.
A second new species of *Gnathothlibus* Wallengren (Lepidoptera: Sphingidae) from Vanuatu. 115

POPPLE, L.W.
A new species of *Cicadetta* Amyot (Hemiptera: Cicadidae) from Queensland, with notes on its calling song. 107

WOOD, G.A. AND MÜLLER, C.J.
The life history of *Toxidia inornata inornata* (Butler) (Lepidoptera: Hesperiidae: Trapezitinae) 139

ISSN 1320 6133